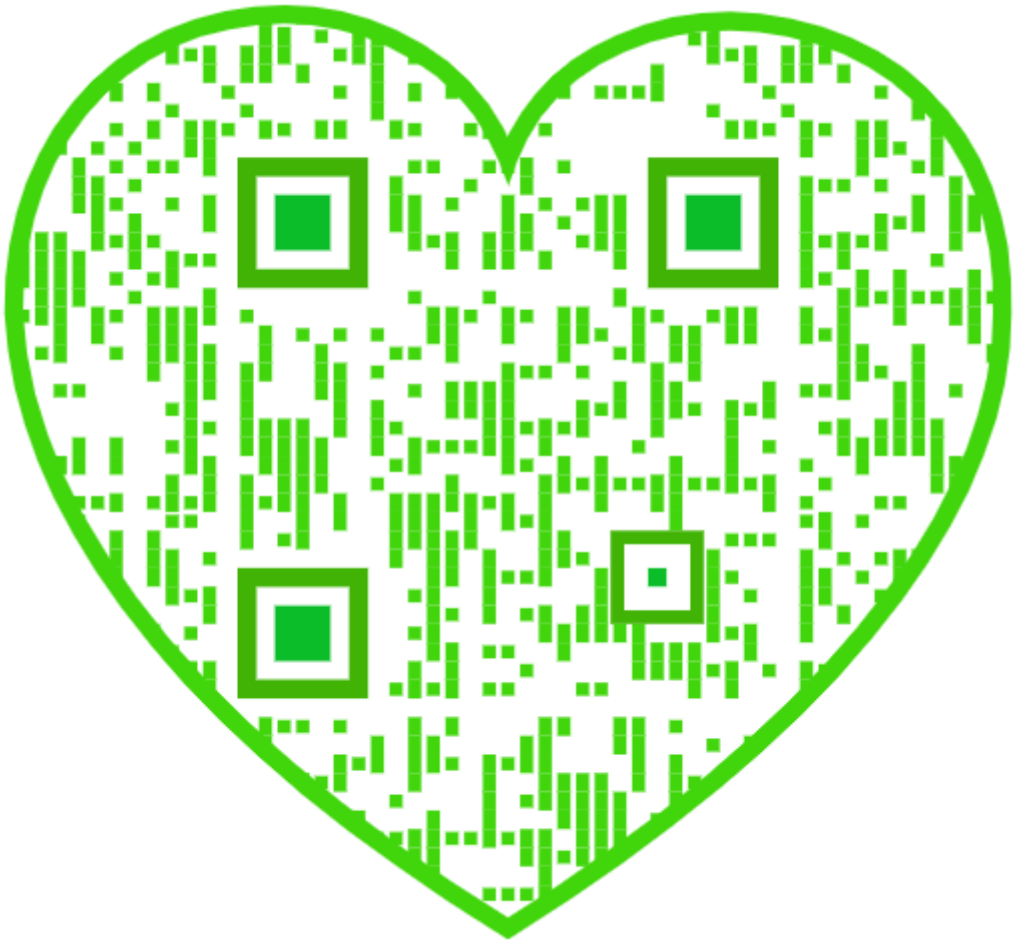

# WHOLESOME HOUSES.

"Let our hearts be bound as the heart of one man to say that, so far as we have power, so help us God, no man, woman, or child in Britain, be he prince or be he beggar, shall die henceforth of preventible disease."—CHARLES KINGSLEY.

"Nothing better can be desired. The system devised by Mr. Banner is as near perfection as may be."—*Sanitary Record.*

"The conclusion I have come to, after considerable time spent upon their study, is that they (the Banner appliances) are the best media for the work which they are intended to compass, that I can confidently recommend them, and that they ought to be specified by architects."—WILLIAM EASSIE, Esq., C.E., author of 'Sanitary Arrangements for Dwellings,' &c.

*"SANITAS SANITATUM OMNIA SANITAS."*

# WHOLESOME HOUSES:

## A HANDBOOK

OF

## DOMESTIC SANITATION AND VENTILATION.

BY

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MEMBER OF THE SOCIETY OF ARTS; FELLOW OF THE ROYAL COLONIAL INSTITUTE;
MEMBER OF THE SOCIAL SCIENCE ASSOCIATION;
MEMBER OF THE SANITARY INSTITUTE OF GREAT BRITAIN;
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*NEW AND REVISED EDITION.*

WITH A CHAPTER ON
VENTILATION OF ROOMS AND RAILWAY CARRIAGES.

BODLEIAN
MAY 1882

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1882.

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# PREFACE

## TO THE PRESENT EDITION.

In preparing a new edition of 'Wholesome Houses,' the author has not only rearranged the chapters and their contents, but has added a considerable amount of new matter. This has been done in order to render the work not only an exposition of the "Banner System," but also a popular handbook and guide to the leading features of domestic sanitation and ventilation. A chapter has also been devoted to House and Railway Carriage Ventilation, and another to a *résumé* of the controversies which have arisen out of the Inventor's claims and the criticisms which have from time to time appeared, from which it will be evident that not only is the "Banner System" a new one, but that it is highly appreciated. The author has, however, endeavoured to exclude all such matters as are of no special interest to the general reader. Since the public introduction of the "Banner System" at Brighton in October 1875, it has been under continual notice, not only in the pages of the *Architect*, the *Builder*, the *Building News*, *Iron*, the *Engineer*, the *Sanitary Record*, *Public Health*, the *Metropolitan*, &c., but also in several leading text and other books upon

Sanitary Science, and the true principles the Inventor has propounded have become universally accepted as sanitary axioms.

While the author admits that imitation may sometimes be the sincerest sort of flattery, he cannot at the same time help feeling that, waiving for a moment the legal aspect of the question, he has rights which, on purely moral and honourable grounds, ought to be a little respected and acknowledged.

Although the "Banner System" as a system remains unaltered and unalterable, the experience of four years' practical work on a very extensive scale has resulted in reducing the expense of its application.

E. GREGSON BANNER.

11, BILLITER SQUARE, E.C.
1*st January*, 1882.

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# WHOLESOME HOUSES.

## CHAPTER I.

### DEFINITION, AND SHORT HISTORICAL SKETCH OF SANITARY SCIENCE.

THE above-mentioned science is one of recent origin, and is known also under the names of Hygiene, Public Health, Preventive Medicine, and State Medicine; and among the various definitions it has had from different writers, that by Dr. E. D. Mapother, in his 'Lectures on Public Health,' in 1869, is generally considered as the most acceptable. He describes it as "an application of the laws of physiology and general pathology to the maintenance of the health and life of communities, by means of those agencies which are in common and constant use." In many of its practical aspects this subject has been extensively treated under the head of Hygiene by Dr. E. A. Parkes and other eminent sanitarians, and which term is aptly said by Dr. Oesterlin, a famous German medical writer, to be "that part of our knowledge which has to do with the preservation and furthering of the health of individuals on the one hand, and of the community at large on the other." From the description thus given of it, and

what it embraces, sanitary science will rank as one of the most important of the age, as it is capable of accomplishing some of the greatest benefits of, and preventing some of the worst dangers to, humanity.

Now, although regulations for the preservation of public health occupied a prominent position in the Mosaic code, and by the ancient Greeks and Romans, they were totally disregarded and practically prohibited during the Middle Ages, owing to the contempt and neglect of all care of the body, and the possible prevention or diminution of zymotic diseases circulated by the religious ascetics of those times. In this country the only considerable legislative measures which were passed for public hygienic purposes, up to an advanced period of the present century, were for averting the course and mitigating the effects of the plague, cholera, small-pox, and other virulent and contagious diseases. The Report on the Sanitary Condition of the Labouring Population of Great Britain in 1842, and the Reports of the Health of Towns Commission in 1844 and 1845, and those of the Metropolitan Sanitary Commission in 1847 and 1848, were the foundation of our modern hygienic legislation; while the Public Health Act of 1848 was the first important statute which passed in furtherance of this great reform. Since that period not only has the progress of sanitation been very rapid, but its scope and utility has greatly expanded.

This excellent result may be said to be due, firstly, to the important testimony given before, and the Reports of Royal and other Commissions and Select Committees of the House of Commons on the subject; secondly, to the debates in Parliament, and the comments on the same by the Press, and the numerous statutes relating

to Public Health; thirdly, to the establishment of the Local Government Board in 1871, and the adoption of the division of England into urban and rural sanitary districts and authorities by the Public Health Act of 1875, and which vested in them great powers to promote the health of the people; fourthly, by the valuable reports made respecting public hygiene by this Board, its inspectors, and the medical officers of the local sanitary authorities; fifthly, by the discussion of preventive medicine by committees of the British Association for the Advancement of Science, and at our Social Science and at other Societies' congresses and meetings; sixthly, by the establishment of hygienic exhibitions and associations; seventhly, by the newly arisen and rapidly increasing profession of sanitary engineers; eighthly, by the numerous patented inventions which have been brought out in connection with sanitary engineering during the last few years; ninthly, by the publication of many scientific and other text-books and pamphlets, and a vast number of encyclopedic periodicals and newspaper articles, and a few excellent manuals and hygienic dictionaries relating to it; and tenthly, by the more extensive and critical notice taken of sanitary engineering and preventive medicine generally by scientific and miscellaneous newspapers and periodicals.

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## CHAPTER II.

### SEWAGE: SEWER GAS AND ITS POISONOUS AND DANGEROUS EFFECTS.

It must be self-evident that the most important section of State medicine is that which is the means of getting rid of the greatest injury to the health of the general public; and one of the chief of these is by sanitarians admitted to be the foul and poisonous air which emanates from sewers and drains and soil pipes of houses and other buildings.

The composition of the refuse from which this gas issues is, according to the first Report of the Rivers Pollution Commission, issued in 1866 (being the best definition given of it),—

"a very complex liquid. A large portion of its most offensive matter is, of course, human excrement, discharged from water-closets and privies, and also urine thrown down gully-holes. But mixed with this, there is the water from kitchens, containing vegetable, animal, and other refuse; and that from wash-houses, containing soap and the animal matters from soiled linen. There is also the drainage from stables and cow-houses; and that from slaughter-houses, containing animal and vegetable offal."

The noxious air from this sewage, says Mr. Baldwin Latham, is compounded of several gases, as "carbon dioxide or carbonic anhydride, nitrogen, carburetted hydrogen, sulphuretted hydrogen, ammoniacal compounds, the vapour of water, and fœtid organic vapour." By far the most poisonous of these effluvia, in the opinion of Sir Robert Christison, Bart., M.D.,

of any of known composition, is sulphuretted hydrogen gas, and which Dr. Alfred Taylor, another of our leading toxicologists, says, "when breathed in its pure state is instantaneously fatal, . . . . and excites equally deleterious effects upon all animals." So deadly is the poison that from authentic scientific experiments which have been made with it, 1 part of the effluvia with 250 parts of atmospheric air will kill a horse, and at one-half of this intensity it will kill a dog, while a rabbit was killed in a few minutes by being placed in a bag of sulphuretted hydrogen gas, though its head was not enclosed, and it could breathe pure air quite freely. In his excellent treatise on "Poisons," published in Ziemssen's recent 'Cyclopædia of Medicine,' vol. 17, 1878, Professor Boehm, of Dorpat, tells us that the richest source for the generation of this gas is

"the putrid decomposition of animal substances; . . . and this is the most frequent cause of cases of poisoning, since these sources of danger are most naturally to be found in the immediate vicinity of human habitations, and although the sulphuretted hydrogen in these cases is almost without exception mingled with other gaseous products of putrefaction, such as carbonic acid, ammonia, &c., yet experience has taught us that it is almost exclusively the *sulphuretted hydrogen* which constitutes the poisonous and dangerous part of the mixed gases."

This statement is also corroborated by Eulenberg, another Continental toxicologist of celebrity, who has made some appreciable remarks upon the terrible effects of this gas. Much important information has also been communicated respecting the changes produced in the blood by sulphuretted hydrogen from the recent critical investigations on the subject by Hoppe-Seyler, Kaufmann and Rosenthal, Diakonow and Preyer, which cannot fail to be of considerable service to scientific

sanitarians. Dr. B. W. Richardson has also stated that he thinks sulphuretted hydrogen effluvia is the only true cause of sewer-gas poisoning.

In treatises upon toxicology and in medico-jurisprudential works relating to such, the *Annales d'Hygiène*, the 'Army Medical Report for 1861,' Dr. Parkes' 'Practical Hygiene,' 5th ed., 1878, and the sanitary and medical periodicals and newspapers, several cases are mentioned of persons being killed by inhaling sulphuretted hydrogen gas.

"Two particular diseases," says Dr. Parkes, "have been supposed to arise from sewer air, namely diarrhœa and typhoid (enteric fever)," and adds, that the latter malady

"may arise from the effluvia from sewers is a doctrine very generally admitted in this country, and is supported by strong evidence. There are several cases on record in which this fever has constantly prevailed in houses exposed to sewage emanations, either from bad sewers or from want of them, and in which proper sewerage has completely removed the fever. . . . This evidence is supported by cases in which the opening of a drain has given rise to a decided typhoid fever, as well as to a very fatal disease (probably severe typhoid), in which coma is a marked symptom. So also in some instances (Windsor and Worthing) the spread of enteric fever has evidently been owing to the conveyance of effluvia into houses by the agency of unventilated sewers. In a case mentioned to me by a friend, an outbreak of enteric fever in a training school was localised in certain parts of the school (whereas the drinking water was common to all), and was traced to imperfection of traps in those parts of the house which were affected. In this case the drains led down to a large tank at some distance, and at a much lower level, and the smell of the effluvia was so slight that at first it was not believed that the drains could be out of order. A very good case is given by Surgeon Page, of the 6th Dragoons, in his description of an outbreak of typhoid fever, at Newbridge, following discontinuance of the use (on account of repairs) of a ventilating shaft for the sewers. Sewer gas got into the barracks and several cases (some fatal) of typhoid fever occurred. Other possible causes

were carefully inquired into and eliminated. These two classes of facts seem decidedly to show a causal connection between the effluvia from sewers and excreta, and enteric fever, and they are supported by the statistical evidence which proves that the prevalence of typhoid fever stands in a close relation to the imperfection with which sewage matters are removed. The Army statistics give excellent instances of this, and the evidence produced by Dr. Buchanan of the prevalence of typhoid fever before and after sewerage of a town is to the same effect."

In the evidence before, and in the Report of the Health of Towns Commission, Mr. Simon's Reports, Dr. Letheby's Reports, Dr. Acland's Reports on sewers in agricultural districts, and the Reports of the medical officers to the Privy Council, will be found abundant testimony in support of Dr. Parkes' assertion as to the fevers occasioned by sewer air. I have thought it opportune to quote the lengthy statement by Dr. Parkes on this subject on account of the very eminent and influential position he held as a teacher of practical hygiene, and because he is justly esteemed by all our sanitarians as the greatest authority on the subject.

In the *British Medical Journal* for the 10th of January, 1880, an account is given of a most alarming epidemic which lately broke out at Pittsburg, in the United States, in which, during the two years ending the 31st of July, 1879, no less than 984 deaths occurred from diphtheria among a population of about 145,000 inhabitants. This disease is attributed to the very defective state of the sewers in that town, and particularly one in Washington Street, "in which a mass of filth from one foot to three feet in depth had accumulated. . . . . The sewer had not been cleansed for twenty-eight years, and in 1877 was choked for 2000 feet of its length."

## CHAPTER III.

### THE GENERATION OF SEWER GAS, ITS ENTRANCE INTO HOUSES, AND THE IMPORTANCE OF VENTILATING HOUSE DRAINS AND SOIL PIPES.

In communicating the results of his experiments on the production of gas from sewage, Dr. Letheby stated that a gallon of this refuse, containing 128·8 grains of organic matter, gave, when shut out from the air, in nine weeks, 1·2 cubic inches of gas an hour, containing 73·833 of marsh effluvia, 15·899 of carbonic acid, 10·187 of nitrogen, and 0·081 of sulphuretted hydrogen. Mr. Baldwin Latham also informs us that the air of every sewer and house drain is daily subjected to frequent expansions and contractions caused by the admittance of hot or cold water, and so great is the force exerted by the expanding air of drains under an increased temperature that no ordinary trap will resist its pressure.*

Again, the inlets by which sewer gas may find its way into a house are very numerous. Dr. Carpenter mentions the following under the plans in use prior to 1875:—

"1. It may find admission through the trap of the water-closet *when no ventilation* has been provided for the soil pipe of the closet itself.

"2. It may enter through defective joints or fissures in the soil pipe, such defects being the result of bad workmanship, of accident, or decay.

* Professor Reynolds appears to make light of this pressure.

"3. Through any pipe, which is in communication with the sewer, which is for the purpose of conveying away waste of any kind, such as housemaids' sinks, butler's pantry sinks, and baths, which communicate direct with the sewer.

"4. Through any pipe which is used as an overflow from wash-basins, baths, cisterns, &c.

"5. Through the catch-water tray which is placed beneath the water-closet in all expensive water-closets.

"6. Through rain-water pipes communicating *direct* with the sewer when *they open in enclosed positions* or *near to open windows.*

"7. Catch-water drains, which generally exist in cellars and areas under cover, and which are supposed to be trapped by a bell trap."

Most of the connections enumerated are *supposed* to be trapped by some modification of *a siphon. It is now admitted that siphons are liable to be delusions and snares for entrapping the unwary.* Any one may prove this for himself by watching a glass siphon, similar to an ordinary siphon trap, when put into action, and then thrown out of function for want of water. The long leg of the tube sucks the short leg dry, and untraps the bend. It follows from this, that *all traps which depend for efficiency upon a siphon action are practically useless.* If their function has been brought into play for the prevention of an overflow, when the overflow ceases the trap is at once untrapped by the long leg of the siphon itself, whilst it is also as certain that, if the function has not been exercised, the water which was put into the trap has evaporated and *left a clear channel for the conveyance of air into the house without let or hindrance.* It must follow, therefore, that traps which depend for efficiency upon water being always present in them will fail *unless a provision is made for the arrest of the siphon action. This provision is the exception which is seldom present. Not one in ten*

*thousand contain the required protective action, and siphon traps without it are worse than useless.*

Again, house drains proper are, in nine cases out of ten, improperly constructed, and therefore are pregnant sources of constant danger. They do not flush clean each time of use; they are often of improper materials irregularly and carelessly laid. They, with the soil and waste-water pipes, are always generating and always full of sewage gas, and to crown the list of sanitary evils, our water-closets are so constructed and of such a pattern that, given perfect drainage and perfect sewers, the very nature of the closets themselves must give rise to a state of things dangerous to health.

In October 1874, in a letter published in the *Sanitary Record*, I urged the legislative compulsory abolition of all traps of the D class. This suggestion is now partially carried into effect. In all places where the Model Bye-laws recently promulgated by the Local Government Board are adopted, these abominations must now disappear. It is greatly to be regretted, however, that the adoption of these bye-laws is merely permissive and not compulsory.

Dr. Carpenter, in calling attention in 1874 to sanitary evils common to all houses, well remarks that—

"The air contained in an upright soil pipe must get into an unsafe state for people to inhale if it is allowed to find its way into sleeping, or, indeed, into any inhabited rooms. This has now become an established axiom of sanitary science. The air in soil pipes must be stagnant for many hours together if no means are taken to 'ventilate' them, and when used, every gallon of water which passes down must displace a nearly equal volume of air, which will necessarily find its way either through the traps or through some of the junctions into the water-closet, and thence into the house."

D traps, however modified, always contain soil; no rush of water can be made to flush them, and here must be pointed out the fact, that in very few houses is the water as supplied to closets able under any circumstances to perform its appointed work, viz. carry the contents of the pan direct, without stoppage or resting, to the sewer. The water leaves its burden for after cargoes to push on or slowly dissolve, in the meantime the deposited filth is decomposing and producing a constant supply of sewage gas.

Dr. Letheby further states that when atmospheric air is admitted into sewers, the gases are carbonic acid and nitrogen, and with but mere traces of sulphuretted hydrogen.

The ventilation of the receptacles of sewage gas is considered by all sanitarians as the greatest requirement for the benefit of the public health, and as Mr. Baldwin Latham properly says, in those places where a good system of sewage ventilation has been effected, this improvement has not only checked disease and death, but has considerably prolonged the average duration of human life. Now the ventilation of the drains and soil pipes of houses is quite as important as that of sewers, as the two former cannot be efficiently ventilated by the latter, nor the soil pipes by the drains; therefore sewers, house drains, and soil pipes require their own separate ventilation.

It is much to be deplored that so badly have domestic drains and soil pipes been ventilated that the great majority of our dwellings remain, in the words of Mr. John P. Seddon, "*mere deadly fever traps, whether they are mansions in Belgravia or cottages in the suburbs.*" That this is no exaggerated statement our pioneer

sanitarian, Mr. Robert Rawlinson, C.B., has been a recent witness, as chairman of the Royal Commission upon the Sewage and Drainage System of the City of Dublin. He states he has no hesitation in saying:—

"That there is not a single residence in Dublin or in its vicinity, or a single nobleman's residence in Ireland, which, if its drains and sewers had not been scientifically dealt with within the last half-dozen years, is in a satisfactory condition; that is, if there are any sewers or drains at all, they are in a bad, dangerous, and unwholesome condition. I know these facts, and this induces me to draw the attention of parties residing under such conditions to the danger they are running into, as, if they value their money more than they value their comfort and their health, they may be living under conditions when their life is not worth twelve months' purchase if anything occurred to develop the elements of evil to which they are quietly submitting by leaving their residences in such a state. Now, as to Dublin, you may sewer it to perfection, you may purify the Liffey, you may scavenge and do everything you can, but if the persons who possess wealth, and who are living in these large houses which have old drains, do not take thought and get their premises not only examined and face the expenditure, they will continue to live under conditions that must tend to great discomfort, and probably shorten the lives either of themselves or some members of their families."

What Mr. Rawlinson says of Dublin is true of London or of any town or village in the United Kingdom. The aggregation of individuals and the increasing density of our population have long since rendered obsolete the simplicity of Mosaic sanitary conservancy. It has been said, "Happy is the nation that has no history." It might also be said, "Happy is the nation that has no drains;" and there are many sanitarians who still contend that the only drains which should be allowed are well-constructed open gullies of the type we yet meet with in old Continental towns. No house into which one particle of sewer gas can find

its way is a wholesome one under any circumstances, as the foul emanations from sewers are most debilitating, and with the slightest breath may be inhaled a zymotic poison. Therefore all householders should at once follow Mr. Rawlinson's advice and have their drains and closets examined by a competent sanitary engineer, if found perfect, the expense will be a mere trifle; if found imperfect, the knowledge gained will in all probability save not only many pounds annually by preventing sickness, but also dear and valuable lives.

In the case of new houses the owners should insist on a plan, with details, of the drainage and ventilation. In the case of new works, the cost of perfect sanitary appliances is less than that usually incurred for dangerous and faulty work.

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## CHAPTER IV.

### THE BANNER SYSTEM.

It is beyond doubt that before the date of the Banner patents numerous contrivances were suggested and patented with the view of excluding sewer gas from houses, but none of them were effectual, and in no single instance was the replacement of foul by fresh air in soil pipes thoroughly effected before the introduction of the Banner inventions.

In support of this statement the following from the *Sanitary Record*, as well as numerous others at the end of this book, may be quoted :—

"In point of value as a sanitary invention, the patent trap and foul-air-withdrawing cowl of Mr. Banner, of Brighton and London, were the gems of the exhibition. We say this advisedly, for if

there are two contrivances more than any others in the way of sanitation that have puzzled our inventors, the house trap and the drain ventilator are those two. The trap invented by Mr. Banner has been several times referred to in our pages, and a description of it attempted, but without woodcuts it is quite impossible to do justice to it. We shall shortly be placed in a position to illustrate this trap with its last improvement, and also the cowl for use upon the ventilating pipe in connection with the drain. Meanwhile we will venture to say that Mr. Banner's system of trapping is a sound one, inasmuch as one trap suffices for the whole house. And we know his method of ventilation is a good one, because he introduces a current of air into the foul-air pipe and the cowl perpetually draws it out. He also showed by experiment that without an inlet of air into the ventilating pipe no cowl will work as a foul-air extractor."

My system of a tripartite arrangement of trap, inlet pipe, and cowl, consists of a trap fixed at the foot of the soil-pipe of a house, which guards the communication between it and the drain; an inlet to the pipe at its base; and an exhaust cowl fixed at the top of this pipe.

This system entirely prevents any sewer gas from forming within or entering the house, while its condition can be inspected at any time without trouble or expense. One of the Banner cowls consists of a funnel-shaped tube placed horizontally on the end of the elongated soil pipe, and is always kept with the wider end facing the wind by an ordinary arrow or other arrangement. This patented cowl, unlike all others, produces a draught which, though varying according to the wind, is continuous. It has aptly been expressed that "the atmosphere is an element which watches its opportunity to exercise a beneficial influence. The Banner ventilating cowl is its most powerful and constant helpmate." As this cowl is constructed so as to exert always a considerable suction force, air is constantly drawn in at the inlet

and made to flow up the soil pipe until it is discharged at the cowl outlet, or if preferred and a little more expense is not objected to, the current may be brought down the soil pipe, over the inner trap, and out up an independent pipe having the cowl fixed upon it above the roof.* Another essential part of my system, and which forms part of my patent, is the disuse of any trap below each closet, and the use of one trap only at the foot of the soil pipe, however many closets may deliver into it.

I will now mention the principal details of my system.

The gas of which *a drain or sewer is always full cannot, unassisted, rise up a vertical shaft*, and the best agent to utilise in order to afford such assistance is the wind, which in this country blows at an average velocity of 10 miles an hour or so all the year round.

It is well known that *liquid* will not flow out of a cask unless the vent-peg, to admit air, is taken out, but it has hitherto escaped attention that to *withdraw* air from a soil pipe, especially foul air, a mere outlet is not enough, and that in order to do so, and keep up a constant current of air, *some extracting power is also necessary* (as shown at Figs. 1 and 3), even if the cask, or tube, or drain has two tubes inserted into it and they be open at *both ends*. Therefore it is now contended that, for thorough or true ventilation, *mere inlets and outlets* are insufficient; because FOUL air or gases *so* "vitiated" do not rise to the highest points, but diffuse themselves throughout the area of the whole space, even though the *hottest* air *so* "vitiated" does rise to the highest level in any room.

* A system recently claimed as novel and patented!! Like the voltaic pile, the Banner system is reversible.

Some people profess to believe that, "in obedience to the never-failing law of nature," *foul* gases must rise and give place to others, *because the latter are heavier.* This theory, in the majority of cases, is in reality a mere excuse for ignorance, or indifference to the great principles involved, and will certainly be admitted as untenable as soon as the law of *the diffusion of gases* is properly understood.

When the shell of a rotten egg is first broken it causes an intolerable stench. After fresh air has passed over the shell awhile it affords very little proof of its having contained putrescent matter; the same purified condition is produced in the *soil pipe* of any house by passing fresh air up it constantly, and nearly the same would be the result in the case of a drain or sewer, or of a ship's hold, thoroughly ventilated on the *vacuum* or induced current principle of the Banner system of sanitation.

When the terrible stagnation which at present exists in sewers and drains is prevented by better flushing and *thorough* ventilation, *dangerous gas* will cease to be generated and stored in *them,* but until then the Banner system is the only one which will render our houses safe.

The Banner system of sanitation, in its *entirety,* may be described thus:—A single trap suffices for the soil pipe of the whole house, and only pure fresh air is allowed to remain in the soil pipes or drains of a house for a single moment; while, under the old system—that universally adopted *in* houses hitherto—there is a multiplicity of traps and other costly contrivances employed, which are not only useless but dangerous, since the application of them results in the soil pipes and drains

being kept constantly "full to the brim of sewer gas" from year's end to year's end.

It is therefore hoped that the truth of the facts, as stated above, will force conviction upon unwilling minds, and satisfy even them, not only that the Banner system of sanitation is the best and safest, but also the cheapest, and that the continuance of the old system cannot but be attended with the greatest danger.

*A full and fair comparison of the Banner and other systems is fearlessly challenged,* in the confident belief that it will result in the influence of the few whose pecuniary interest may possibly be affected by the necessary change, not being allowed to override common sense, and by so doing perpetuate a state of things which will *still endanger not only the lives of more members of the Royal Family and of the nobility of the land, but continue to destroy and seriously affect, in many untold ways, yearly, hundreds of thousands of the community at large* — whether they live in the palaces of the Queen herself, in the splendid mansions of the most wealthy everywhere, or in the poorest dwellings — by allowing houses still to remain "DEADLY FEVER TRAPS," as stated by Mr. J. P. Seddon at page 106.

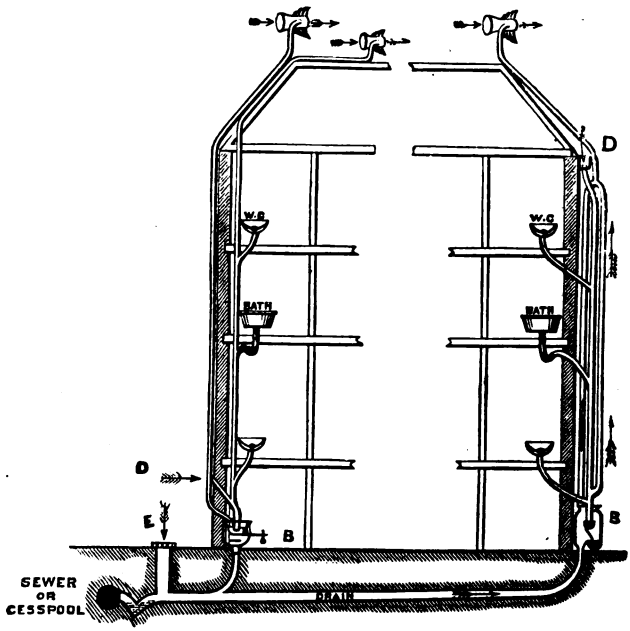
Such a statement as the foregoing would be most reprehensible if it were untrue, and it is only upon conviction that it is substantially and perfectly true that it is made.

Figs. 1, 3, and 13 represent the mode introduced by me for *thoroughly ventilating the soil pipe* and the *house drain,* each by means of a separate shaft; the two being joined *near the top,* as shown in Fig. 3, one cowl mounted

thereon above the roof *can* then be made to suffice for both.

D is the inlet by which external air is led into the soil pipe immediately above my patent drain trap B,

FIG. 1.

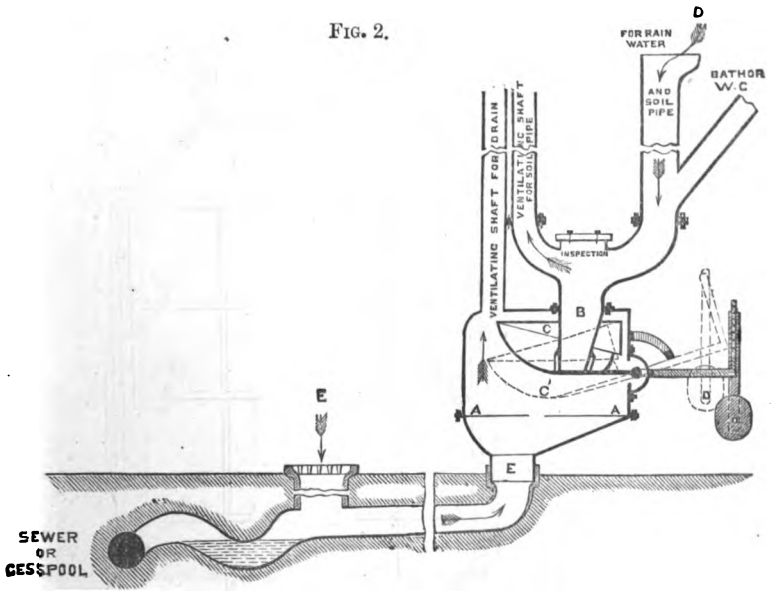



thereby admitting, by the action of the patent cowl fixed on the top of the soil pipe carried above the roof, of a constant current of fresh air through it.

The "inlet" for fresh air to the soil pipe a little above the trap on the basement, may be by a short pipe for that express purpose, or the rain-water pipe from the roof may be employed. The "inlet" to the drain E may be a rain-water pipe from the roof of the house or

that of an adjoining building, or it may be through a grid to convey also surface water into the drain at ground level, as shown.

FIG. 2.



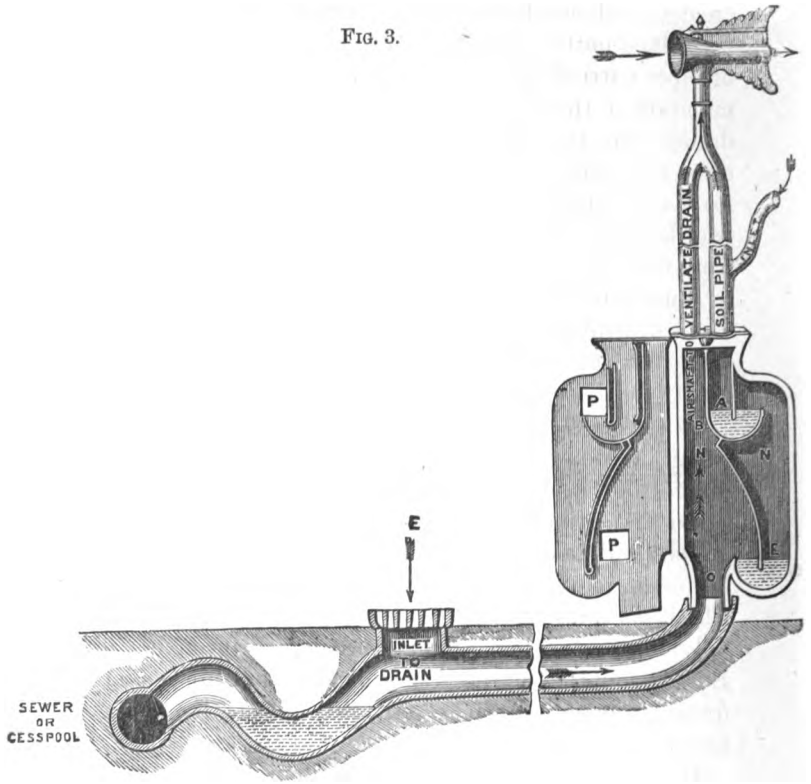

The above is the mode introduced by the Lever trap, patented 1st August, 1872, as exhibited at the International Exhibition in 1874, and afterwards at the Sanitary Exhibition at Glasgow in October 1874.

The conditions to be dealt with vary in different houses, and great care is therefore necessary in arranging the details so as to ensure the thorough efficiency of the system.

The gases formed in *the drain* will escape therefrom at *the lowest point*, viz. at the "ventilator" (so called) at the ground level, unless the cowl be used to make the "ventilator" always an "inlet." *From actual*

*experience we are able to certify that with a 4-inch Banner ventilating cowl a constant current of fresh air can be made to course along a* HORIZONTAL *drain a*

FIG. 3.




The above shows a simpler trap for effecting the same object as that shown in Fig. 2. Patent dated 2nd July, 1875, No. 2401.

*distance of over one thousand feet while the sewage is passing down it in the opposite direction.*

E shows the same plan applied to the drain, which may

be extended to *the sewer*, by means of which the present road or street "ventilators," so called, would become *inlets*, whereby a constant current of fresh air would be created, and, accelerated by the action of the patentee's cowl fixed on the top of a sufficient number of shafts or pipes carried up outside houses, would be constantly maintained throughout not only the house and street drains, but the sewer itself, causing the whole to be always as pure, comparatively, as are the pipes *within the house* where the patentee's system is adopted to ventilate the *soil pipe*. Rain water should be led direct from the roof through the sink or basement trap so as to flush the house and street drains, instead of, as now, destroying the roads, stopping up the gullies with detritus, and at last silting up the main sewer itself.

As self-preservation is the first law of nature, everything in the way of sanitary action ought not to be left to the "sanitary authority."

On the principle, "Take care of the pence, the pounds will take care of themselves," if *all* the house drains were ventilated *outside* the houses, the sewers, which at present are dangerous, would become not only innocuous, but would cease to be inconvenient. By the adoption of the same plan vitiated air may be drawn from any room in a house or from the cabins, forecastles, or holds of ships.

In carrying out the "Banner system" of sanitation, as a matter of choice, the author prefers to use his own patented appliances. But the system is independent in principle of any special appliances; for in the words of a very eminent sanitary engineer, "it is not a trap, it is not a closet, it is not a cowl—it is a system." It

consists of, as has been before stated, a tripartite arrangement of trap, inlet pipe, and exhaust cowl; and the use of this combined arrangement by other parties is an infringement of the Banner patented system; but on this subject more will be written later on.

It is only in very exceptional cases that either of the foregoing TRAPS need be used, but the author thinks this book would be incomplete if he omitted to give here a full description of both of them. Beginning, then, with the trap (Fig. 4), when it was invented it was thought that to prevent the inflow of gas from the sewer into the house was the chief thing required, and this was found to be impossible with the ordinary forms of traps then in use.

Banner's patent drain trap effected that most important object. *It is entirely self-acting and always perfectly air-tight; it flushes clean and cannot be unsiphoned.* The arrangement is novel, and effectually prevents *at all times* the escape of *sewer* gas into the house, while it dispenses with the ordinary forms of D and other traps used in connection with water-closets, the universally acknowledged inefficient action of which is a constant source of danger. The very construction of D traps prevents a clearance of soil from them ever being effected, and they therefore become generators of impure gas, which is freely admitted through the "container" into the house each time the closet is used, and the gas from the sewer is also constantly *drawn* through them and through faulty pipes *into the house*, by the varying temperature of the latter, which is facilitated by the siphon action of one closet upon another when there are more than one in a house. D traps, again,

often become "choked" by foreign substances, such as hair, cork, &c., passing into them; and as the closet must be taken down before the D trap can be got at, a plumber has to be employed, and great expense is consequently incurred before the obstruction thus created can be removed.

In a multitude of counsellors there may be wisdom, but in a multitude of traps within any house there is absolute danger; for it is now admitted that with soil-pipes carried above the roof, and merely left open at the top, the whole system of closets, traps, and soil pipes within every house remains, as already stated, constantly full of sewer gas from one year's end to another, and while the first cost of so many traps is very great, the frequent expense incurred in trying to keep them in order is even still greater.

By the employment of the lever trap shown in Fig. 4, all the evils from *sewer* gas were entirely obviated, for neither pressure, suction, nor siphon action could affect it; and one trap fixed like a gas meter inside or outside the house, in any convenient place in the basement, was sufficient for a house containing several closets.

The lever trap consists of a small air-tight chamber A, of cast iron, or other material, fitted with a 4-inch inlet pipe B, which projects several inches into its interior; the lower end of this inlet, surrounded by an indiarubber band, sprung on and slightly projecting beyond the end of the pipe, is closed and made air-tight by a copper cup C, of peculiar form, which is pressed up to it by a suitable *weight* D mounted upon a lever fulcrumed on an air-tight centre, and having its outer end bent upwards at a right angle. The

*weight* is suspended by a link on the raised end of the lever, and is so arranged that when the pan is in the act of tilting, C, the centre of gravity of *the weight* D

FIG. 4.

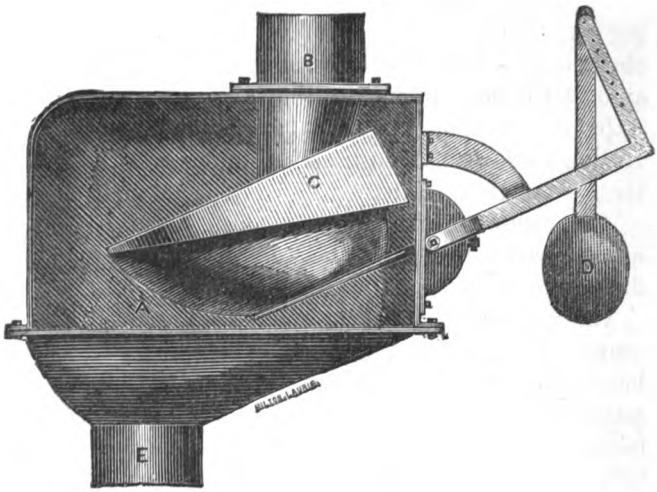
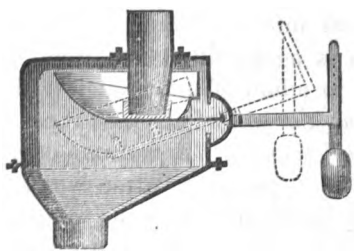



FIG. 5.



The patent for the above trap is dated August 1, 1872, No. 2303.

is brought nearer the fulcrum, thus reducing the load and allowing the pan C to remain tilted, without at any time unsealing the trap, till it is thoroughly

flushed, yet retaining sufficient power to completely close the trap again after flushing. A series of holes in the raised end of the lever permits of a proper adjustment of the *weight*, and a bend in the soil pipe, just above the trap, breaks the force of the water reaching the latter from above. The lower part of the chamber E is formed with sloping sides, terminating in an outlet in connection with the drain.

*Before flushing*, the cup, when full, weighs *over* 15 lbs., while the utmost weight opposed to it on the lever is *less* than 15 lbs.

*After flushing*, the cup and clean water left in it weigh *under* 7 lbs., while the weight on the lever after flushing is *over* 7 lbs.

The column of water in the soil pipe B, Fig. 4, cannot rise more than 12 inches *above the chamber*, but the weight on the end of the lever is sufficient to maintain *in the soil pipe* a permanent column of several inches of fresh overflow water, besides the clean water left in the bottom of the cup after each thorough flushing, till the closet is again used and its contents are discharged into the drain, when the copper pan filling again is again tilted and remains down sufficiently long to admit of a thorough flushing (*but at no time unsealing the end of the inlet pipe, as will be seen from the dotted lines in the engraving, which shows the pan in its tilted position*), after which the trap is brought back by the action of the weighted lever to its normal position, when, besides the air-tight valve thus formed, there is a water seal of three inches in the cup, and several inches up the soil pipe.

A small piece of pipe from *outside* the house to a little *above the trap* may be safely and advantageously

used to lead external air into the soil pipe, and thus there will be established a constant current of fresh air throughout all the pipes *between the trap and the cowl fixed on the soil pipe carried above the roof of the house.*

A separate pipe may, if thought desirable, be fixed *into the chamber*, and taken up above the roof of the house, *to ventilate the drain*, as shown in Fig. 2.

This is a most advantageous form of trap for all low-lying districts, where there is danger, in times of flood or high water, of the drains returning their contents into the basements, as the greater the pressure of the returning sewage matter towards the chamber below the trap, the more tightly is the copper pan closed against the end of the soil pipe inlet, so that no flood-water, sewage, or sewer gas can possibly be forced past it into the basement or any other part of the house; *a desideratum which cannot be obtained by any other trap.*

The outer end of the lever being exposed to view, in the event of any foreign substance causing a stoppage, it can be readily remedied by a domestic in two or three very simple ways.

Fig. 4 shows the cup valve in the position it takes while flushing, when the opening is increased from the diameter of the inlet pipe above it, to 12 inches.

The outlet from each closet is so arranged, without being trapped, that whatever can pass through it will freely pass through the patent trap in the basement.

In Fig. 3 is a diagram of another house-drain trap patented by me, July 2nd, 1875, No. 2401, the "Double Dip Trap." While it is less expensive, having no movable parts, it is nevertheless almost as effective as

the patent lever trap for the complete exclusion of sewer gas from the house. Its great advantages over the ordinary siphon or dip trap are manifold and apparent; like the lever trap already described, it is self-acting, always air-tight, flushes clean, and cannot by fair usage be unsiphoned by any action whatever of the sewer or otherwise; it may be used to ventilate the soil pipe only, or the sewer or cesspool also; or, if preferred, only the soil pipe and house drain, by a pipe of any desired diameter led from it, outside or inside the house, to above the roof and having a cowl mounted thereon. One trap in the basement, inside or outside the house, will suffice for each soil pipe having any number of closets, and placed in any cupboard or recess, or against the wall, only occupies a distance therefrom of five inches, while there is a vertical fall of *two feet* between the two dips. The space between them, which is always air-tight, would hold, if it could be filled with water, over two gallons, the weight of which alone would then exercise a downward force of over 20 lbs. on the lower dip, while the fall of water from the upper closets, sometimes as much as 40 or 50 feet, will always keep the upper "dip" completely free from any possibility of the slightest impurity ever remaining in it for a moment, precisely as in the case of the lever trap. The trap is larger than the soil pipe to be carried up from it; the soil pipe may be curved a little just above the trap if desired, but the *direct* action of the water falling from above into the first dip ensures its being kept thoroughly clean at all times. The admitted extreme weakness of ordinary siphon gully traps is not only their great liability to be unsiphoned by the least suction action of the sewer, as well as in many other

ways, but where they *can* be placed outside houses, for which there is no convenience in the small close areas of town houses, provision has necessarily to be made for frequently cleansing them in consequence of their great liability to become foul, owing to the greatly diminished force with which the water, &c., from the closets, however high above, dribbles into them after passing a great length of drain pipe, often under the floor of the house, *horizontally* for some distance before the siphon trap—probably situated under an *open grating in an area*—is reached. Many other inconvenient and otherwise serious objections to this mode of trapping are too apparent to need further mention here. A very serious one is forcibly pointed out in the earlier part of this book, which shows that the sewer gas is often forced by the action of the sewer itself through the water in such traps. As has been clearly shown by Dr. Fergus, of Glasgow, foul matter is retained in ordinary traps, and consequent decomposition goes on. The inlet, *as introduced by the patentee*, to convey external air to the foot of the soil pipe just above the trap, whether used without or in conjunction with a ventilating cowl or ventilator above the roof, for the purpose of establishing a constant current of fresh air throughout the whole of the pipes inside or outside the house, is admitted by all who can speak authoritatively upon such a matter to be a point of importance and value, constituting a great stride in sanitary science. It needs no charcoal tray or other nonsensical contrivance, such as is by some said to be necessary for ordinary siphon traps, to *prevent the escape* of poisonous sewer gas at the ground level when they are placed in areas outside houses, *as by the action of the cowl above the*

*roof, the "inlet" in this system is always really an inlet for fresh air, and never an outlet for sewer gas.*

This being the result of my system, I have introduced and patented a simpler and much cheaper form of trap which can be safely used.

In Figs. 6, 7, and 8 * are sections of single dip traps for the foot of a soil pipe. By their use both the house drain and the soil pipe can be ventilated, inside or

FIG. 6.

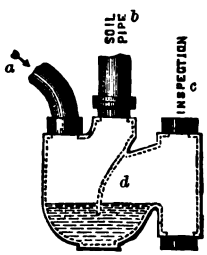



FIG. 7.

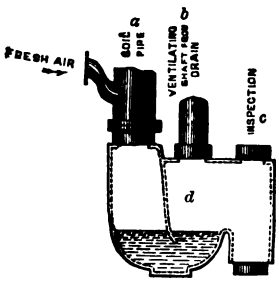
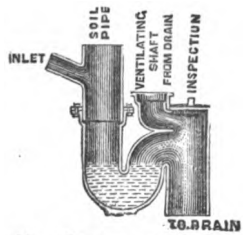



FIG. 8.




New Design and Trade Mark.

outside the house, without any of the impure or solid matters, which of necessity must pass through them, being exposed for a moment, while the movable cover plate affords ready means for cleansing, in case such should at any time become necessary; but as the closets are so many feet above them, they are practically always self-cleansing, and are the only patent traps for inside the house having the advantage of a direct fall of several feet into them.

It may be not unreasonably asked which of all these traps is the one finally recommended. Circumstances alone can answer this question. In most cases it will be perfectly safe to employ the simplest form of trap.

* These traps are made of superior earthenware and of iron, which may be had rendered rustless by the Bower-Barff process.

But cases sometimes occur, as when the sewer forms a *cul de sac*, that the more expensive trap had best be used.

Having described the traps in detail and with them the inlet, the third adjunct to the Banner system is the cowl. Of patent cowls and ventilators the inventor has several varieties, and as with the traps, each has its special advantages and each may be relied upon to thoroughly perform its work.

The very great advantage of a foul-air-withdrawing cowl being mounted on the soil pipe above the roof is, that it ensures *at all times* a current of fresh air *up* the soil pipe, while without it the wind would blow down any pipe open at the top, and then the most poisonous sewer gas which passes the water in an ordinary trap or "disconnection" would be forced out at the *intended* inlet, to the great danger of persons on the basement floor, or at open windows.

This most important fact must never be lost sight of —GAS *from a sewer or drain* CANNOT, UNASSISTED, RISE UP A VERTICAL SHAFT.

In confirmation of this I may refer to the following experiments Professor von Pettenkofer has made respecting the motion of air in drains:—

"*The Motion of Air in Drains.*—For the healthiness of dwellings it is obviously an important question whether the air of the drains, charged with vapours and small organisms, moves upwards or downwards. At the instance of Professor von Pettenkofer, Herr von Rozsahegyi has recently made experiments as to this in the Ludwig and Max suburb of Munich, using sometimes vapour of sal-ammoniac, sometimes smoke from flames, sometimes sulphuretted hydrogen gas, as indicators of the direction of the air-motion, while the strength of the draught was measured with a Recknagel anemometer. The principal results of the inquiry are these:—The motion of the air in the Munich drains is much more downwards than upwards. The draught in the lower portion of the drain

system is stronger than in the upper. Upward currents occur but very seldom, and they are limited to very short portions of the drains. The prevailing direction of the wind has no marked influence on the direction and velocity of the air-current in drains. The temperature of the drain air was, on an average, 3·2° to 5·6° C. lower than that in the open air, but the observed air-movements in the drains are not explained by this. Where house drains join street drains the air goes oftener outwards than inwards, and this partial movement is also independent of the prevailing wind direction. The out and in motion at such places is not constant, but variable. Through these junctions, when near the houses, an exchange of air may occur between one house and another, if efficient water traps are wanting. The predominant downward air-current appears to be due simply to the current of liquid matter. The experiments are to be repeated in winter, when the temperature in the drains is higher than that in the open air."

The patent for the first Banner cowl is dated October 5th, 1874, No. 3400. For a full detailed and scientific description of it see p. 90 in the Appendix. The small sizes were specially designed for soil pipes and drains. Used with an "inlet" it would be useful; without such inlet no cowl can be of any use. It is here necessary to give a caution against the use of any weak or spurious imitations of the original Banner cowl; for it is well to bear in mind what has been very appropriately said, that—

"A new invention is brought before the public and commands success. A score of abominable imitations are immediately introduced by the unscrupulous, who in copying the original closely enough to deceive the public, and yet not so exactly as to infringe upon legal rights, exercise an ingenuity that employed in an original channel could not fail to secure reputation and profit."

Each Banner cowl is numbered, and has affixed to it a brass label bearing the words "Banner's Patent Ventilating Cowl." This novel ventilating apparatus supplies the want of the age, and should be used uni-

versally. It is inexpensive, and though it is simple in construction, its action is so important and effectual that no house having a water-closet in it should be without one fixed on the soil pipe and carried above the roof, as well as one on a pipe or shaft led from the drain to ventilate it. It will be found most useful in many other ways, to draw off vitiated air from heated rooms in public buildings, banks, offices, schools, stables, granaries, washhouses, ships' holds in which cargoes, alive or otherwise, are liable to become overheated, and from the cabins and forecastles of vessels; also smoke and heated air from railway carriages, &c.

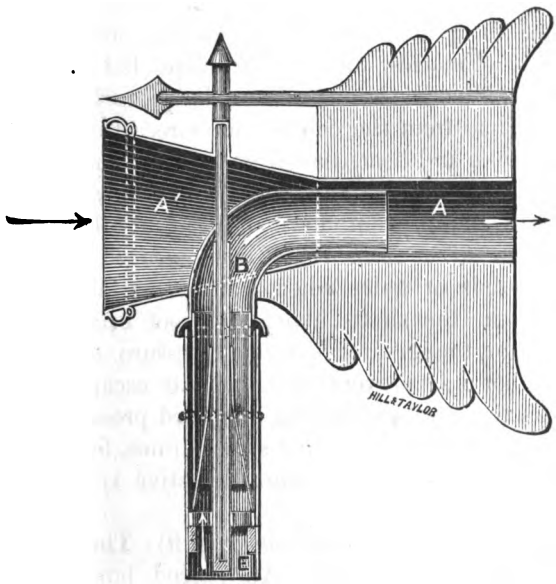
The great use of this cowl is not only to *draw off* foul air and prevent down draught at all times, *but especially to do both when most needed;* viz. during high winds or gales when, without it, all the mere outlets in the shafts above the roof become closed, owing to the greater external pressure of the wind, which not only prevents the foul air escaping at such outlets then, but, by causing increased pressure from all points within the sewer and street drains, forces the gas *thus locked into them*, through defective traps, *into the houses.*

Its action is as follows (see Fig. 9): The larger end of a funnel-shaped tube $A^1$, placed horizontally, is always directed towards the wind, and a current of air passing in there, is pressed forward through the annular space between the two cylinders A, B, and when it reaches the end of the inner one B it expands all round it, and in its passage out at the smaller end of A A a vacuum is created round *the point* of the inner cylinder B, which by suction *draws out* its contents into the open air, and thus induces an upward current of air

from the shaft or pipe leading from the place to be ventilated.

To be effectual, an inlet for admission of fresh air into the soil pipe, a little above the trap on the basement, is indispensable; and the *annular space* between

FIG. 9.



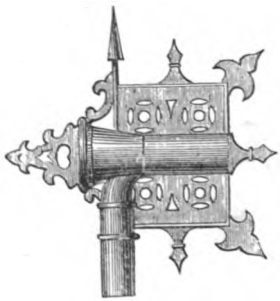

the tubes of the cowl itself, as well as the *length* of the latter, must be in certain proportion to their sizes.

By the adoption of this simple apparatus in conjunction with Arnott's ventilators, a most beneficial effect is obtained.

The cowl-testing experiments at Kew have been so adversely criticised and censured that it is hardly

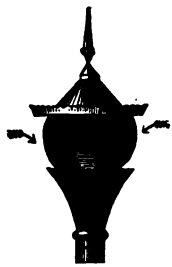
necessary to refer to them again. The Banner cowl was not one of those experimented upon, therefore the author can speak more freely on the subject. It is now universally considered that the whole affair was

FIG. 10.



New design of Cowl and Trade Mark.

FIG. 11.



Down Draught Cowl.

useless, and the judges themselves have admitted that the results obtained by them were not satisfactory.

The officers of the Metropolitan Board of Works made some independent experiments with several kinds of cowls, and the result was that the Banner cowl showed an excess over an open shaft in 24 hours of 144,000 feet, and over two rival cowls of 97,920 and 270,720 feet respectively. The fixed ventilators are all so constructed as to induce the swiftest current of air possible, and are constant in their action.

I received the following from Mr. H. H. Collins, F.R.I.B.A.:—

"61, OLD BROAD STREET, *July* 22, 1878.

"I have used the two cowls, and it will be interesting, perhaps, to you to know that, in seeking to ascertain what ascensional power my ventilating tube had before your cowls were fixed on, I discovered a direct down draught; but immediately upon putting on your cowls the smoke ascended with the same rapidity that it did

when I tried it at your Brighton residence, and, indeed, as I have invariably found to be the case. It is very necessary that you should publicly refute the false notion which the imperfect experiments at Kew have created, because I know that only last Friday your cowl was intended to be used, not by me, but by a builder, and the man laughed at the idea of using it, and referred the builder to the letter in the *Times*. Unfortunately, people read with their eyes open but with their minds firmly closed, and no inquiry seems to be made whether effects are due to right causes or whether the authority is worthy of credence. I believe in your cowls, and I think that probably I am as impartial a judge as can be had, because I candidly confess that if I knew a better cowl I would most certainly employ it in preference to yours.

(Signed) "H. H. COLLINS."

In order to assist in overcoming the great indifference which unfortunately prevails to so grievous an extent in the minds of the community to the adoption of the new system of sanitation, from the uncertainty as to whom they can rely upon to have no more than the simple alterations and really necessary work carried out properly, I will here point out the great difference between the old and the new mode of dealing with the drains and soil pipes of houses, and which is clearly shown in the following illustrations (see page 37):—

Fig. 12 shows the very dangerous way in which the drains and soil pipes of houses were almost invariably trapped, &c., prior to 1875. Both being loaded with sewage, and brimful always of sewer gas, in consequence of a total absence of effectual ventilation in either—the dreadful result produced by hot water passing through them can readily be estimated. Fig. 13 shows the system which had been in use at my own house for some time before I introduced it as previously stated; and before this time, it may be safely asserted, that such a

thing as a thoroughly clean and ventilated house drain and soil pipe was not known. By this method, instead of the drain and soil pipes of houses being coated with filth and full to the brim of sewer gas (as shown in Fig. 12), they are kept clean, and there is a constant current of fresh air made to pass through them at all times (as shown in Fig. 13).

According to the *Builder* for Nov. 26, 1881, there are now considerably more than three times as many inhabited houses in England and Wales as there were in the year 1800; while between April 4th, 1871, and April 3rd, 1881, 575,000 had been added to the number of such dwellings.

The main obstacle to the adoption of my system is no doubt for the reason before stated. It is, however, increased by the unwillingness of plumbers to apply it, because they fancy it would be to their interest to continue the old plan, which, dangerous as it certainly is to the occupiers of houses, is doubtless a constant source of profit to the former in various ways. But as there are millions of houses which require the application of the new system of sanitation, plumbers need be in no fear of not being fully occupied.

All that need be done to render a house safe against typhoid and other filth fevers is to have a trap of any simple kind against the sewer in the drain, with a proper 3-inch inlet for fresh air, and a Banner ventilating cowl on the top of the soil pipe above the roof.

The cost of applying the Banner system of sanitation, including a Banner ventilating cowl, with proper inlet for fresh air, to a house in which there are no special defects, and in which there is one closet, and having a

FIG. 12.

THE ORDINARY METHOD.

SHEWING THE DEFECTIVE & DANGEROUS CONDITION IN WHICH MOST HOUSES ARE

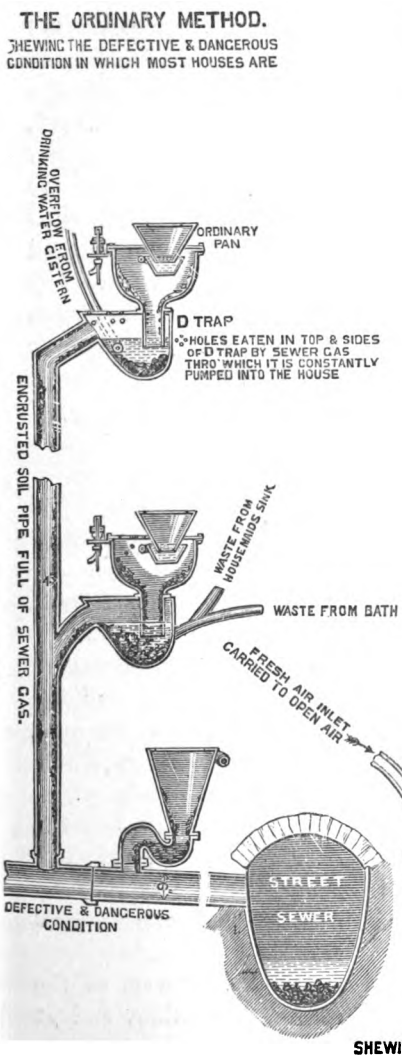
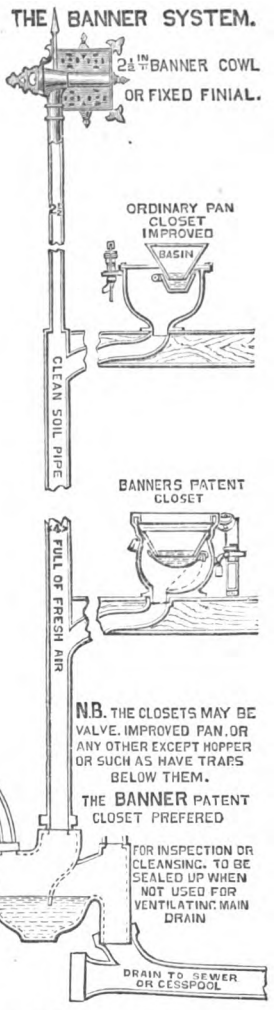

OVERFLOW FROM DRINKING WATER CISTERN
ORDINARY PAN
D TRAP
HOLES EATEN IN TOP & SIDES OF D TRAP BY SEWER GAS THRO' WHICH IT IS CONSTANTLY PUMPED INTO THE HOUSE
ENCRUSTED SOIL PIPE FULL OF SEWER GAS.
WASTE FROM HOUSEMAIDS SINK
WASTE FROM BATH
FRESH AIR INLET CARRIED TO OPEN AIR
STREET SEWER
DEFECTIVE & DANGEROUS CONDITION

FIG. 13.

THE BANNER SYSTEM.


2½ IN BANNER COWL OR FIXED FINIAL.
2½
ORDINARY PAN CLOSET IMPROVED
BASIN
CLEAN SOIL PIPE
BANNERS PATENT CLOSET
FULL OF FRESH AIR
N.B. THE CLOSETS MAY BE VALVE. IMPROVED PAN. OR ANY OTHER EXCEPT HOPPER OR SUCH AS HAVE TRAPS BELOW THEM.
THE BANNER PATENT CLOSET PREFERED
FOR INSPECTION OR CLEANSING. TO BE SEALED UP WHEN NOT USED FOR VENTILATING MAIN DRAIN
DRAIN TO SEWER OR CESSPOOL

BANNER SYSTEM

SHEWING VENTILATION OF SOIL PIPE ONLY.

trap in the drain or at the foot of the soil pipe, and the latter is carried above the roof, would generally not exceed 5*l*. This does not include the cost of removing the trap from below the closet and refixing the closet to the soil pipe, which would cost about 40*s*. or 50*s*. each, and which for mere safety is not absolutely necessary if there be a proper supply of water. This refers to the soil pipe and closet only, which are generally the chief sources of danger, and any respectable and careful builder and plumber can do the necessary work. The whole expense would vary with the size of the house, and the "conditions" as existing, which may have to be dealt with, being faulty or otherwise.

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## CHAPTER V.

### WATER-CLOSETS.

With water-closets as heretofore generally constructed much inconvenience arises in the case of pan-closets owing to an offensive incrustation or deposit which occurs on the inside of the container itself and the back of the basin near its lower opening into the pan, as well as on the inside and outside of the pan itself; and in the case of valve closets, in consequence of the handle being put down or allowed to descend before the contents of the basin have passed out of it, and complete closing of the valve being then prevented by paper or other obstruction so that no water is retained in the basin or closet.

Water-closets are often destroyed by reason of the overflow valve being burst in frosty weather, and at

other times the siphon trap in it is not charged, and if charged is constantly unsiphoned, and so leaves an open way for foul gas to enter the house.

The closet which I have patented is designed to obviate these inconveniences and to afford ready inspection for cleansing purposes, &c. For accomplishing this object I construct the closets in parts, so arranged that any person or servant can readily take apart, or separate, cleanse, and replace the whole.

The receiver is made in one piece of white earthenware with inlet for water and flushing rim A (see Fig. 15); below this rim is a channel B for containing water, and the basin C is made with a turnover rim E

FIG. 14.

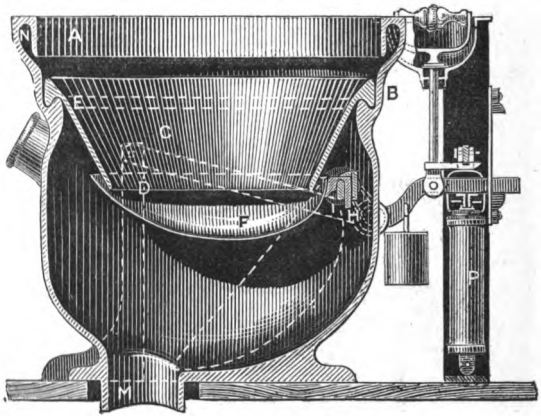
W.C. complete, with Patent Lock Regulator and Valve.

at top to dip into this channel, which forms a hermetically sealed joint; at the same time the basin can be easily removed, which is a distinctive feature in this invention. The saucer F is also of earthenware, and is fitted on a metal bush H, which fits into a slot I in the axle. The axle being short is not liable to get broken

as is the case in other closets. The dotted lines in Fig. 15 indicate the position the saucer F assumes when the handle is raised so as to discharge the contents of the saucer through the outlet M. The whole apparatus may be thoroughly ventilated by an outlet arm as shown in Fig. 14.

A little extra expenditure on the closet will be amply repaid in the future, only it must be borne in mind that it does not necessarily follow that the most costly closet

FIG. 15.

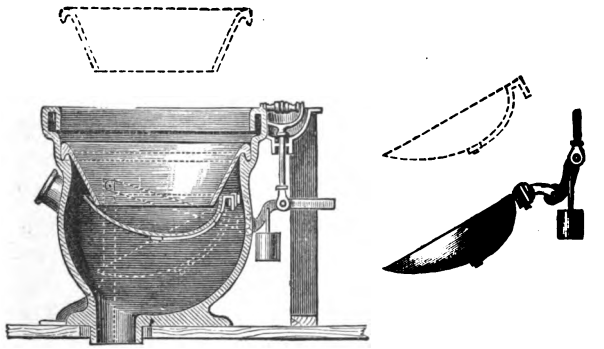



Section of Closet.

is the best. Of course a water-closet requires water, the more the better, but in some towns the supply to a closet is unfortunately restricted by the water companies. This tyranny should be abolished, and the water actually used in a house should be ascertained and paid for by meter, but so long as legal enactments admit of this grievance especial care must be taken to select a closet in which this regulated supply is not

wasted and frittered away. One thing can be done even where a water-waste preventer must be used. The closet can be flushed a second time, so, care being taken to select a closet, without any objectionable encumbrance or addition of the nature of a trap at its base,

FIG. 16.



Section and movable parts.

one that will flush clean and which from its shape will not readily soil as it is used, a site should be chosen as near the outside walls and the soil pipe as possible. The shorter the length of any drain in any house the better. When the Banner system of ventilating the soil pipes is honestly and fairly carried out, there is no necessity whatever for any trap under the closet; this is one of the great advantages of the Banner system, as it enables traps at the base of closets to be safely dispensed with. It must be remembered that these traps are invariably miniature cesspools. It is only in very exceptional cases that a trap can be tolerated under any closet and then it should be of the simplest form possible.

It is of the utmost importance that all the plumber's work connected with a closet should be well and honestly done, and every closet-seat should be hinged so as to allow of ready inspection whenever required. The same as to all drains and pipes, especially within a house. A good deal of controversy has lately arisen as to whether soil pipes should invariably be within or outside a house. This is not a question which can be decided except with regard to the especial circumstances or conditions of each case. There are advantages peculiar to each system, and on the whole, with properly executed work, the inside arrangement is to be preferred. With the severe winters of late experienced, outside pipes are liable to freeze, and this occurring, the nuisance, inconvenience, and expense which it entails are very great. On the other hand, it is asserted that there is always at least a chance of leakage in the case of indoor soil pipes. This will be the result of bad workmanship, but even if such a thing should occur in a house ventilated on the Banner constant current system the danger would be infinitesimal. Both sink and waste lavatory pipes must all be trapped in the simplest manner. This has been urged by opponents as a departure from the "system." It is no such thing, it is merely done to make sure that the ventilating current shall commence at the inlet next to the one sentinel trap and not be weakened by other inlets on the way. Other contrivances than a bend in the pipe could be devised, but a siphon trap is the simplest, care being taken that it shall remain charged. The Banner system is essentially a one trap method, and to call these minor matters departures from the system is a mere cavil.

Borrowing the words from Dr. Carpenter, by the Banner system "a continuous current carries away the sewer-gases before they are concentrated enough to do harm." Indeed, in the completest form of the Banner system no sewer gases can exist in the drains or soil-pipes at all; the house drains being well laid no sewage gas is generated, and to make certainty doubly sure, a current of fresh air is always passing up both them and the soil pipes. Even in the case of imperfect drains the Banner system minimises the danger, whilst in newly modelled good work it absolutely renders it *nil*, for, as the *Builder* says, "it is like turning a stream of clean water through a muddy channel, carrying away all impurities with it."

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## CHAPTER VI.

### RIVAL SYSTEMS.

In reviewing the first edition of my treatise on 'Wholesome Houses,' the *Sanitary Record* called attention to its non-controversial character, and remarks that—

"This is all the more praiseworthy since only recently a writer in the *Times*, in reviewing the model bye-laws lately issued by the Local Government Board, while lauding the system now under review to the skies, went pointedly out of his way to attribute it to Mr. Rawlinson, C.B. Mr. Rogers Field's advocacy of the system dates, we believe, from the day he inspected the 'Banner system' during the meeting of the Social Science Association at Brighton in 1875. Mr. Banner must fight his own legal battles, but, as a matter of moral fairness, we again express our belief that the system advocated in 'Wholesome Houses' was first made public by Mr. Banner."

There is no doubt but that what is so honourably

stated by the *Sanitary Record* is actually and substantially true. Before the date of the Banner patents, all that had been done was in the direction of trapping. Firstly, mere trapping with a large trap was resorted to, and then, finding that no mere water trap was effectual as against sewer gas, an outside trap of simple construction with an air break was recommended, as a certain preventive against sewer gas. This plan had for its first and almost simultaneous advocates Professor Reynolds, F.R.S., Fellow and Professor of Engineering at Owens College (now Queen's University), Manchester, Dr. Syson, then Medical Officer of Health for Salford, and Mr. Molesworth, Coroner for Rochdale. Dr. Syson and Mr. Molesworth both show an inlet and an outlet in their plans published in 1872, but Dr. Syson has publicly disclaimed all intention to ventilate, the existence of inlet and outlet being accidental. In Mr. Molesworth's case, from his circular there does certainly seem to have been an intention to ventilate, but at the most the plan is identical with Dr. Syson's and merely affords an inlet and an outlet. Rather curiously, all these three gentlemen resided near each other, and although Professor Reynolds' plan does not attempt to provide ventilation, yet in the trap and open-air break there is the strongest family likeness.

A patent has been granted to me for my system in America. I applied for three patents there as they were granted here, viz. for the lever trap, the ventilating cowl, and for the double dip trap, including the combination of any trap with inlet to soil pipe a little above the trap, and an exhaust cowl. The two first were granted at once; and the third, for the combination, &c., the examiners at first objected to, as in their

opinion part of the combined arrangement had been anticipated by previous patents, but after an inquiry which lasted for several months the objections of these officials were shown to be groundless, and the patent was granted to me on the 20th of February, 1877, No. 187,503.

During the Brighton Congress, in October, 1875, when I first notified my new system to the public, a large number of the leading sanitarians of England visited my house and examined the method. Among these gentlemen were Mr. Eassie, C.E., Mr. Rogers Field, Mr. H. H. Collins, Mr. Somers Clarke, jun., Dr. Farre, Dr. Hardwick, Dr. Richardson, Dr. Ryalls, Mr. Lewis Angell, and a host of experienced medical officers of health, as Drs. Haviland, Robinson, Syson, Fussell, Taaffe, Kebbell, &c., and not one of these gentlemen raised the slightest question as to the novelty of the invention, and not one had even seen the triple combination before, and now it has become a sanitary axiom.

In confirmation of this statement I may refer my readers to the following letter, published by Professor Fleeming Jenkin in the *Sanitary Record* on the 23rd of February, 1877, viz.:—

"THE VENTILATION OF HOUSE DRAINS.

"(*To the Editor of the* SANITARY RECORD.)

"SIR,—I see many letters concerning the ventilation of house drains in your paper, and the great majority of your correspondents seem to take it for granted that it is desirable to force as much air as possible through these drains. I have no wish to write dogmatically on the subject, but I should be very glad if some of your correspondents would tell me whether there is any experimental

proof of the advantage to be derived from this system as compared with that of simply putting the house drain in communication with the external air by one opening. Up to the present time, my own practice and teaching has been that this single communication was sufficient. The two methods have distinct objects in view. When I ventilate by means of a single opening, I only work thereby to prevent any excessive pressure in the drain by which gases may be forced past traps. I know by experimental evidence, as well as by theory, that if I do not take this precaution foul air will frequently pass into the house from the drain. The advocates of two openings secure the advantage given by one opening, but they aim at much more, they wish so to purify the drain by passing air through it, that no foul air can ever be generated; indeed, they seem to aim at making the inside of the drain at least as sweet and wholesome as any room in the house. This at first sight seems very desirable, and it must be remembered that we buy every increase of purity in the drain by a decrease in the purity of the air round our houses. Earth, not air, seems to me the true purifying agent; earth is benefited by that which ruins air. Certainly our street sewers ought not to be ventilated by having volumes of air passed through them; an open ditch would, on this principle, be the best sewer. Perhaps some engineers might accept this conclusion. All who do not should hesitate before they apply to house drains a treatment which they would not apply to main drains. I am prepared to change my present opinion if it can be shown that in houses which have been well drained with pipes ventilated on the single opening system, bad smells and illness have prevailed until the second opening was added; or still better, if it can be shown that the death-rate in a district has been altered by the addition of the second opening. *A priori* reasoning will not convince me. I doubt the possibility of absolutely sweetening any drain. I do not think well-constructed drains are very foul even when there is no draught through them; I hesitate at the idea of blowing through a house drain lest I should blow some gas where I do not want to blow it, and I object to the contamination of air resulting from its use as a disinfectant.

"In fact, sir, I believe that the sanitary engineer has no greater enemies than his enthusiastic supporters. Knowing as I know the shocking defects of our present house drainage resulting from neglect of the very simplest rules, I feel a little irritation when reading of

schemes for a hygeiopolis with its fantastic precautions against some millionth of a grain of danger.

"FLEEMING JENKIN,
"Professor of Engineering in the University of Edinburgh."

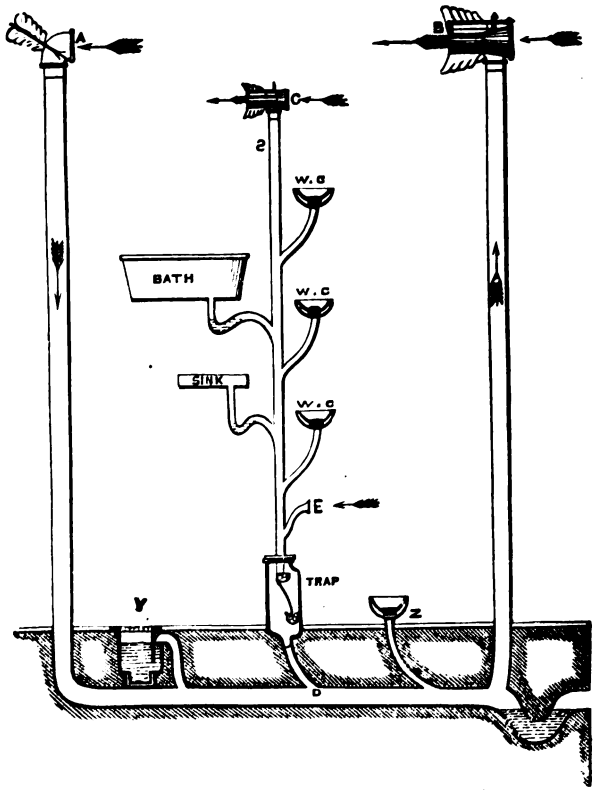
According to the Registrar-General's reports concerning sanitary progress, published in September 1881, the fever death-rate per 1000 in 1874 was ·59; 1875, ·55; 1876, ·45; 1877, ·41; 1878, ·42; and 1879, ·30.

Guy's Hospital was the first large institution at which my system was carried out, in 1876 (Fig. 17). It was afterwards used at Burghley, the residence of the Marquis of Exeter, and has since been adopted at a vast number of other houses, besides at hospitals, various philanthropic institutions, colleges, schools, clubs, hotels, banks, co-operative, and other large premises belonging both to corporations and private individuals.

Mr. Rogers Field, as good an authority as can be found, recently stated at the Hall of the Royal Institute of British Architects that what is known as the "opened-up" soil pipe is new in practice, and that he himself had only adopted it for about six years. Mr. E. Turner informed me that my patented combination was previously unknown to him, and he has subsequently stated—

"I have no hesitation in expressing my own opinion that the ventilation of the trap and soil pipe, by means of a pipe of adequate size, with air-tight joints, carried above the roof with a cowl, or more properly an exhaust ventilator, with, of course, a proper inlet for air, or a ventilating trap, judiciously placed according to varying circumstances, is the best plan that has yet been devised for preventing sewer gas from entering houses.

FIG. 17.




A. Inlet to admission air shaft to drain.
B. Outlet to extraction shaft from drain.
D. Drain.
C. Outlet for air from soil pipe.
E. Inlet for fresh air to soil pipe.
S. Soil pipe.
Y. Surface trap.
Z. Trapless closet.

Dr. Syson also observed that, until I introduced my system, "the endeavours of all sanitary reformers were confined to trapping, with, amongst the most advanced, an outside open-air break," while Major Seddon has still more favourably expressed his opinion in favour of my method by saying that, "in justice to Mr. Banner, the greatest possible credit is due to him for having succeeded in solving a problem which has hitherto baffled all the combined talent of the best sanitary authorities of the day."

As there appears to be uncertainty expressed in some quarters as to whether I am entitled to patent rights in my system, I will mention a few statements from leading judicial decisions, which show that I have a good and legal title to such, even if it is proved that none of the separate parts of my method are new. In the case of *Lister* v. *Leather*, tried in the Court of Queen's Bench in 1858, Lord Campbell, in delivering the judgment of the court, very properly said:—

"If the combination the subject of the patent was new and useful, though each of the parts which entered into it were old, still the combination might be the subject of a valid patent. . . . A patent for a combination is not a claim that each part thereof is new. On the contrary, each part may be old, and yet a new and useful combination of such old parts may be valid, as has been often decided."

This judgment was affirmed in the Exchequer Chamber. A simpler combination patent case in which the doctrine was acted up to was that of *Bovill* v. *Keyworth*, tried in the same court in the previous year, in which the plaintiff's invention consisted in exhausting the air from the cases of millstones, combined with the application of a blast to the grinding surfaces. The patentee specifically disclaimed the precise details of

carrying out his invention, as described in his specification. It was proved by the defendants that both the blast and the exhaust had previously been used separately in working mills. The court, however, held that "the whole of the plaintiff's process, if the combination be new, is certainly the subject of a patent." So, too, in the case of *Hinks* v. *Safety Lighting Company*, decided in the Rolls Court in 1876, Sir George Jessel observed that:—

"The very essence of a combination patent is that it is a new combination of known parts, and in fact very few machines are now invented which contain any new part. As a general rule, every machine invented is made up of parts which are previously known. A new part of a machine is very uncommon indeed; consequently that is an objection which *per se* is not of great weight. But like every combination which is new, it must have merit; and now, how is a judge to apportion the merit? I do not know. As far as I can ascertain from the authorities, the merit very much depends on the result produced, where a slight alteration in a combination turns that which was practically useless before, into that which is very useful and very important; judges have considered that though the invention was small, yet the result was so great as fairly to be the subject of a patent, and, as far as a rough test goes, I know of no better."

Again, in the very recent case of *Hayward* v. *Hamilton*, relating to "Improvements in Pavement Lights," tried in the Court of Appeal on the 24th of May, 1881, Lord Justice Bramwell said, in favour of this doctrine:—

"It is as old as the world that a prism used as the plaintiff uses it will direct light in the way his prism does; and the other part of his invention is not new, that is to say the particular mode in which he makes his pavement light; but the combination is a novelty. The thing was never patented before, and undoubtedly a combination of two old things may be made the subject of a patent. It seems to me, then, that the plaintiff really is an inventor—he has found out something. He makes an article that was not made

before. This particular case may be, no doubt, upon the verge; but one cannot help making the remark that it is very strange if it is no invention that it has never been done before. Why, because nobody else found it out, which I take to be an equivalent to inventing, and I think, therefore, this patent is sustainable."

I regret very much to trouble my readers with the latter part of these remarks, but in justice to them and the advocacy of honesty among patentees, as well as for the protection of my own just rights, I have been induced to do so.

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## CHAPTER VII.

### VENTILATION OF ROOMS AND RAILWAY CARRIAGES.

For more than twelve months after my new system of sanitation was patented, it was limited to the ventilation of sewers, drains, and soil pipes. On the 2nd of November, 1877, however, I obtained a patent for the ventilation of rooms, amongst other plans, by means of or through a chandelier with telescopic arrangement, whereby I give fresh air at the spot required, and in like manner withdraw that which is vitiated and has become unfit for respiration. It is impossible to lay down any hard and fast lines for the ventilation of rooms, so much depends upon size, situation, and construction. It is admitted on all hands that to breathe a vitiated atmosphere is baneful in its effects, and often dangerous. Especially are the kitchens in houses, large and small, overlooked in this respect in the present era of closed fireplaces. What is required is to change the air by continuous circulation, without violent currents or unpleasant cold draughts. Again, the ventilation of a room should be either self-regulating, or easy of regu-

lation, according to the number of persons from time to time occupying it. In many cases it is practicable to warm the fresh air before or on admission. How important mistakes may be made in details is shown in the case of the recent much-trumpeted ventilation of the Custom House. With regard to this establishment, I found that the inlets about 5 feet from the floor were covered with books and ledgers; and upon my asking the reason of this, I was told it was "because we feel a great draught;" and some important alterations which were afterwards made at my suggestion to obviate this have been found to be a great improvement.

Mr. J. P. Seddon, F.R.I.B.A., has well and pithily said that he thought it "was as necessary to lay on air to houses as water, and that by other means than the soil pipes which in nine cases out of ten were the only pipes that admitted air when the windows were shut."

I will now mention the particulars of my plan for ventilating rooms, from my complete specification, which, as the *Sanitary Record* for July 5th, 1878, says, is so clearly worded, "that those who run may read, and no paraphrase of ours can possibly render it clearer or more easy to understand." This document is as follows, viz.:—

"The object of my invention is to improve and purify the air within and around dwellings and other buildings, and in all the pipes and conduits connected therewith.

"To do this I form what may be called an air chamber below the firegrate, or stove, or gas burner, placed in any position, and have a chimney or other special uptake shaft leading from such to above the roof of the house.

"Air conduits are carried up by the sides of or in the walls themselves of the house or building to the roof or otherwise outside it, or as tubes, pillars, pilasters, or columns of any desired form within the room or place itself, and openings are made from them at

any points between the floors and the roofs or ceilings in any fanciful or other manner at their capitals, or other highest points, or at any other points in any ornamental way desired. I cause such openings to communicate down, along, and by means of the aforesaid conduits direct with the air chamber below the firegrate or stove, or with the special uptake shaft which may be placed in any position in the room or place to be ventilated, or in an adjoining place. I stop or lessen as desired such communication through all the air conduits by one or more valves near the air chamber which may be regulated at pleasure, or in like manner at any one or more of the several conduits which may lead from different parts or points, external or fresh air, or the heated, vitiated or other air of the room or place to be ventilated into the air chamber or uptake shaft. To increase the effect of this arrangement I close up temporarily or otherwise, and in any convenient way, the whole of the front of the fireplace, or of the coal grate, or gas stove or burner, in such a way that air passing to the fire or burner shall reach it entirely or mostly from below it or through the air chamber near the firegrate, by which means I cause the fire or burner to draw for its consumption air (foul, vitiated, heated, or other) from the highest or any other levels (in the room) direct instead of allowing the hottest or most vitiated air in the room to stagnate or rest near the ceiling till the air in the whole room becomes inconvenient, hot, impure, and unhealthy before it can pass at the level of the fireplace, which is below the point of respiration, to the fire and up the ordinary chimney or out at such other places, called ventilators, as are sometimes provided, but which admit only of an occasional escape of an excess of air in a room from it. The fire or burner by suitable arrangements may be left visible always or temporarily.

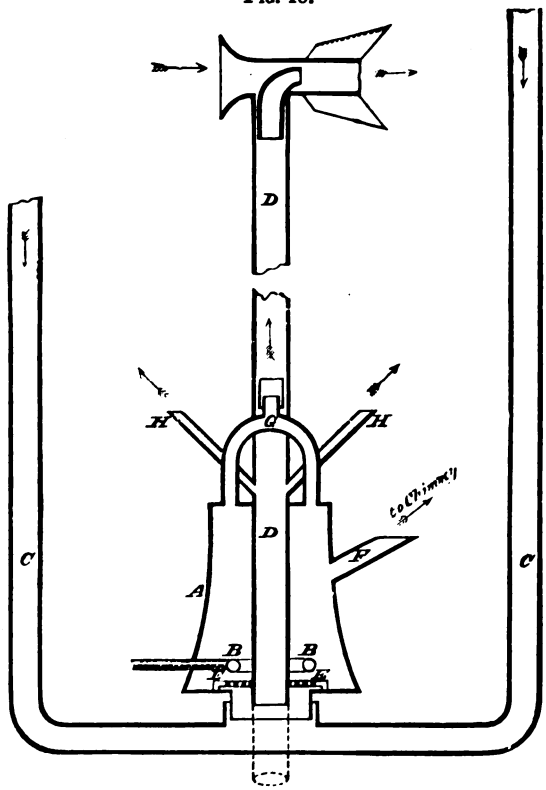
"In summer, or when there is not a fire, the chimney shaft is utilised in like manner as above for the improved or thorough ventilation of the rooms, by closing up the front of the fireplace with a plate of looking-glass in a suitable frame or in any other convenient and ornamental manner.

"This arrangement is particularly adapted at all times for the thorough ventilation of bedrooms or other sleeping or sick rooms, and down draught in a chimney will also thus be avoided. For the purpose of inducing or increasing the draught up the chimney or other uptake shaft or pipe led from the room or place to be ventilated, an exhaust cowl or fixed ventilators, constructed as afterwards described, are used.

"Fig. 18 shows a diagram view of a gas stove with air channels

in connection with it, arranged in the manner above described. A is the outer casing of the stove, B a gas burner within the casing, C C air pipes led upwards to any desired height of room, or may, in like manner, be led by tubes and valves to any other room from air chamber below the stove; D, air pipe led up from the air chamber through the centre of the stove and heated by the gas burner outside it.

FIG. 18.




"This pipe or shaft is continued upwards to above the roof of the building, and carries, if desired, a ventilating cowl at its upper end; E, openings for air to pass from the air chamber to the gas burner and the interior of stove; F, outlet for burnt air to pass to chimney

shaft if desired; G, outlet for burnt air to pass (F being closed) into pipe D, to increase, if desired, by its escape there, the exhaust force of the arrangement; H H, outlets for warmed air to pass into the room itself, or be conveyed to any other room if desired. In some cases, when the warmed air is to pass into the room, I make provision for supplying the lower end of the pipe D with fresh air from the exterior of the building instead of with air from the air chamber below the stove. The cowl or ventilator at the top of the pipe or air shaft D may be constructed in the manner described in the specification of a former patent granted to me, No. 3400, in the year 1874, or with cowls or ventilators such as are hereinafter described, or with other forms of ventilator adapted to produce an upward current of air in the pipe or air shaft.

"Fig. 19 shows a vertical, and Fig. 19*a* a transverse section of a fixed ventilator; it is formed of a tube A, triangular in cross section, and with a vertical opening at each angle, as shown; the lower end of the tube A is fixed to the top of the chimney or shaft, up which a current is to be produced; the upper end of the tube A is closed. In place of the triangular tube A being of uniform section from top to bottom, it may taper upwards to a point as shown in Fig. 19*b*, or be of other form in elevation. The sides of the triangle may either be curved inwards, as shown at Fig. 19, or they may be straight, as shown at Fig. 20, or curved outwards, and with projecting lips at the angles as shown at Fig. 21. Each of the three sides might also be brought outwards to a point, making the cross section of the tube approximately of an hexagonal form open at three of its angles and closed at the others, as shown at Fig. 22. With these constructions, when the wind blows against the sides of the tube, in whatever direction the wind may be blowing, it will be passing across two of the outlet openings, and will produce an outward suction through them. In cases where the ventilator is only exposed to currents of air in either of two opposite directions, as, for example, when the ventilator is applied to a railway carriage, the tube may similarly be formed with two openings only, opposite one to the other, and in the line across the direction of the flow of the outer air. The openings may be at two opposite angles of a square or diamond-shaped tube, as shown in Fig. 23, or the sides may be rounded outwards, and radial projecting lips, formed at the edges of the openings, as shown at Fig. 24, or the openings may be formed at two opposite angles of a square-sided figure, with each of the sides curved inwards, as shown at Fig. 25. Or similar ventilators may be made with one opening only. The ventilator would then be of the form of one-half of those shown

in similar ventilators with a single slit or opening, but with the opening at right angles to the tube or pipe, instead of parallel with, or inclined to it, as in the others, as shown at Figs. 26 and 26*a*. In

FIG. 19.

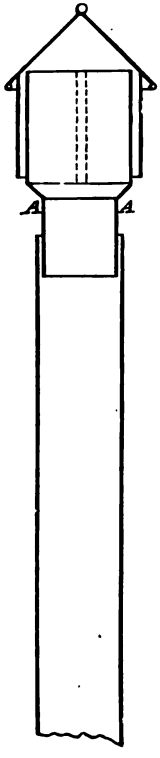


FIG. 19*a*.

FIG. 19*b*.

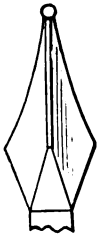


FIG. 20.

FIG. 21.

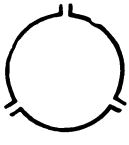


FIG. 22.

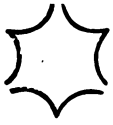


FIG. 23.

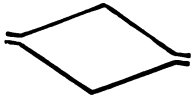


FIG. 24.

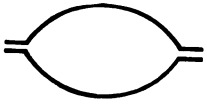
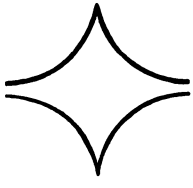


FIG. 25.



end view the slit is shown to be of an S form, but it may be straight or of other form. Such ventilators may be secured to the sides or to the top or bottom of a railway or other carriage ; pipes also may be led from them to any part of the interior of the carriage, so as to draw off air from any desired spot.

"An improved form of revolving ventilator applicable for pro-

ducing an upward draught in any air-shaft or chimney is shown at Figs. 26 and 27; Fig. 27 is a vertical section, and Fig. 27*a* a cross section. It is composed of a short tube A, mounted on a pivot B, and having curved blades on its exterior for the wind to act against to revolve the tube. The lower end of the pivot B drops into a

FIG. 26*a*.

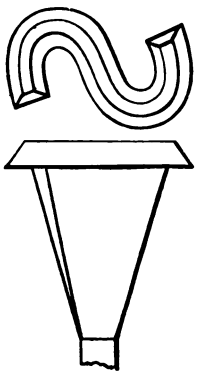


FIG. 26.

FIG. 27.

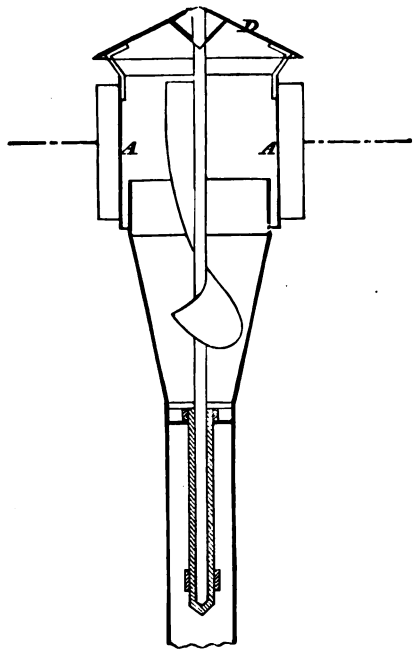
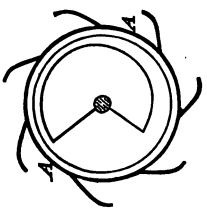



FIG. 27*a*.



tubular bearing carried at the centre of a tube C, which is fixed to the upper end of the chimney or shaft. On the pivot B is an inclined or screw blade, which, as it revolves, causes an upward current which escapes through the open top of the revolving tube; D is a conical cap, secured to the top of the tube A, and revolving with it.

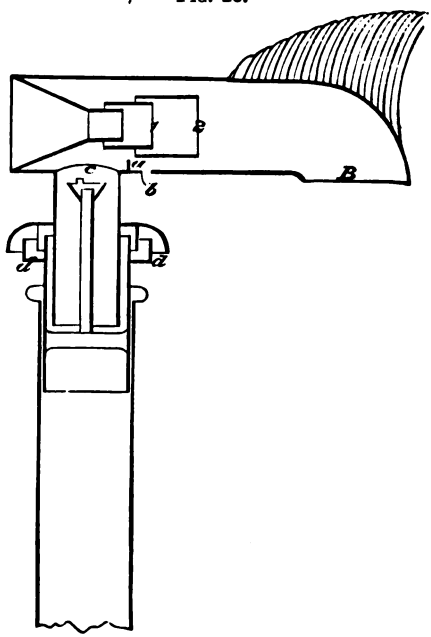
"The above-described centrifugal pump-cowl avoids mainly the known defects in those of the Archimedean screw class and others,

because it avoids rain water or high wind passing down them; and as the only but sufficient escape for the air pumped up is at the top below the cover or cap, and as the screw blade does not retard the free uprising of air when no wind is blowing, it will not be made to rotate, as Archimedean screw ventilators most frequently do, by the action of the current of hot or warmed air naturally passing up a chimney shaft, in the same way as the old smoke-jack for roasting.

"An improved form of cowl is shown in section at Fig. 28; it is a modification of the cowl described in the specification of the patent above mentioned.

"To keep the cowl steadier to the wind, the outer casing or

Fig. 28.

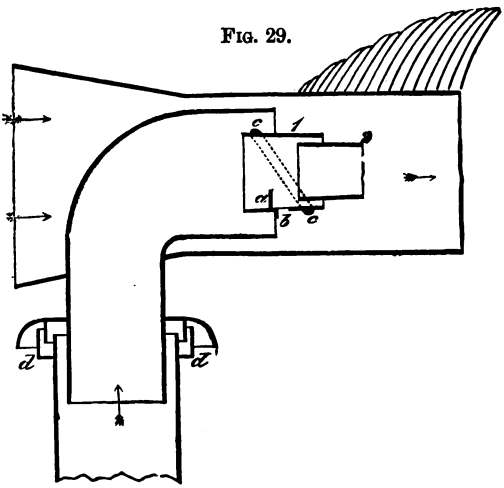



cylinder is made straight or smallest at the wind end, without lessening its exhaust power; to prevent any down draught, when in eddies of wind the cowl sometimes turns round, I turn down the outer end, as at B. To increase the useful effect of the cowl, I put

what I call 'drums' of suitable length and diameter, cylindrical in shape, or nearly so, expanding slightly towards their outlet ends, as one, two, or more, according to the size or diameter of outer cylinder. For the purpose of preventing any rain or water driven through the inlet cone from passing down into any room or place with which the chimney or shaft communicates, I place a small crescent-shaped rim or bead *a* at the bottom of the outer cylinder on its inner side to stop the water flowing down the up shaft, and I pierce a few small holes *b* in the outer cylinder to allow the water to flow harmlessly out of it clear of the rain or wind guard.

"In cases where the exhaust power of the cowl is caused by the wind passing through the annular space between the outer cylinder and the cylindrical end of the up shaft, as shown at Fig. 29, I put similar drums 1, 2, for a like purpose, one or more, according to

FIG. 29.

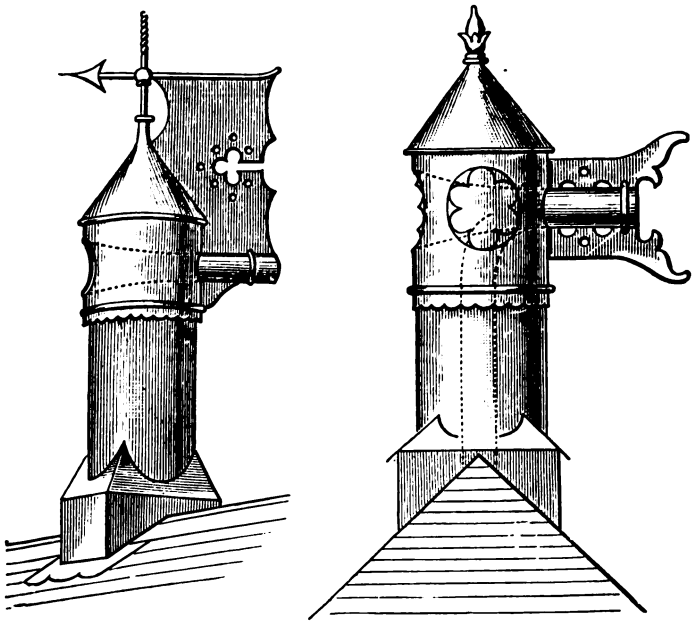



the size of the cowl, within, and from a little behind the end of the up shaft, and I slightly contract them towards their outlet end, and I put a slight bead *c* around the outside of the outer one, and inside it a small crescent-shaped stop *a*, and holes *b*, as already described, to cause any water which may get upon or into the drums to drop into the outer cylinder, so that it may pass away from its inlet or funnel-shaped end, and not pass down the chimney or air shaft. To avoid,

in cases where it may be thought advisable, any loss of exhaust power at the rain guard, I put an extra chamber *d* for the rain guard to work in, as shown at Figs. 28 and 29, and fill the same with glycerine or other liquid not liable to freeze or evaporate.

"For the greater convenience of occasionally oiling the spindle, I put a small covered cup with screw cap, as at C, Fig. 28. Various ornamental forms, in which ventilating cowls, such as hereinbefore described, may be constructed, are shown at Figs. 30. If desired, the

FIGS. 30.

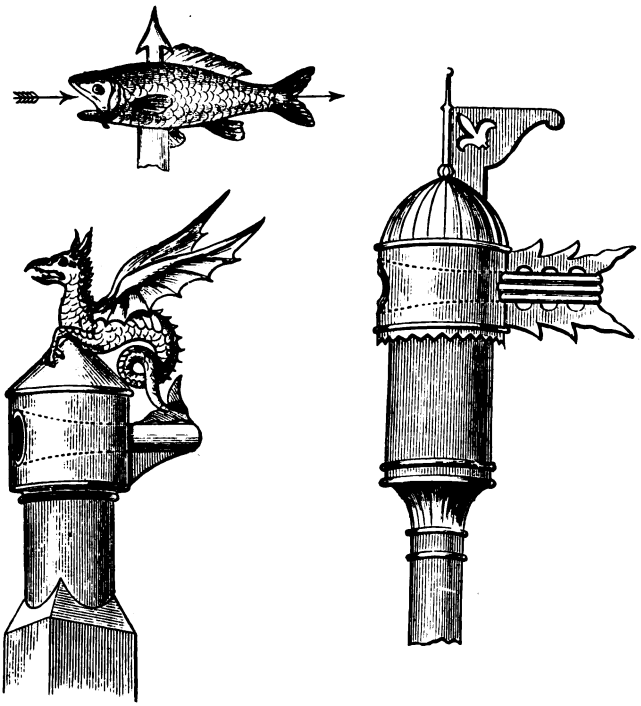


cowl may be of vertical form, as shown at Fig. 31, with the wind inlet at *e*, and outlet at *f*, or a fixed ventilator may be formed, as shown at Figs. 31*a* and 31*b*, where the wind enters at *e*, and rises up between the outer cylinder and the drums 1, 2, and pipe *a*, which is fixed at the top of the chimney or shaft.

"As a further means of preventing any down draught in the up

draught air shafts, instead of carrying the up shaft direct from the room, with its lower end open, I curve it from its lowest point upwards towards the ceiling, as shown at Fig. 32, in any ornamental

FIGS. 30.



way, and I provide a screw cap *a* at the lowest point, so as to be able to empty off any water that may condense in or descend into the shaft.

"This plan is applicable whatever kind of cowl or ventilator may be used for producing an upward current in the air shaft.

"In order to cause or facilitate foul air being withdrawn from any room or place by means of an exhaust cowl, I adopt a fixed injector cowl, arranged to produce a downward current of fresh air through

FIG. 31.

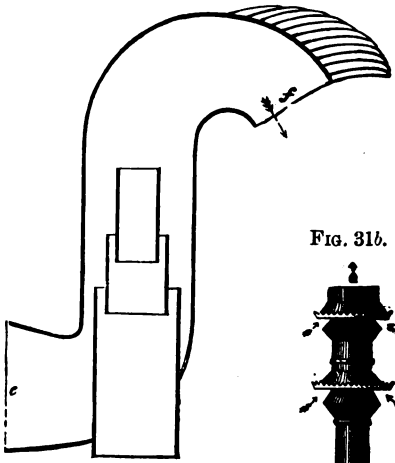



FIG. 31a.

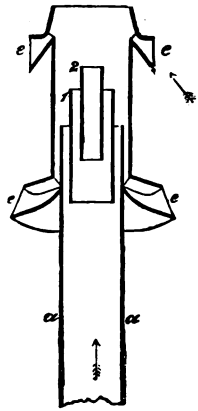



FIG. 31b.

FIG. 32.

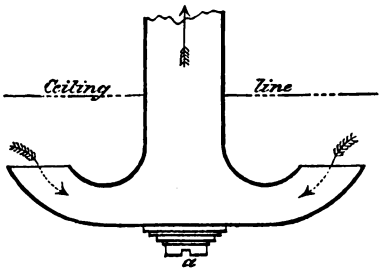
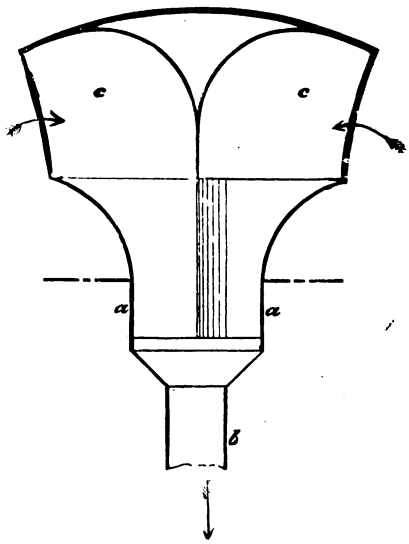



FIG. 33.

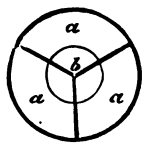


another pipe or shaft led at any convenient point into the room or place to be ventilated.

"A fixed plenum cowl or ventilator formed to press outer air into a room which is without sufficient inlet, the better to ventilate it, as above stated, and to cause an increased current or draught up the chimney shaft, is shown at Figs. 11 and 33.

"The tube *a* is divided into three equal spaces, as shown in the cross section, Fig. 34, each equal to the area of the tube *b*, which forms part of the air shaft. The opening round the top is also similarly divided into three, as shown, so that from whatever point the wind blows it will go down one of the three channels, in *a* to *b* from *c*.

Fig. 34.




"From whatever point exterior to the house the fresh air is admitted or pressed, I lead it into a room or building through, as it were, the arms of a chandelier suspended by preference from the ceiling of the room, and I am thus enabled to bring the air inlets to any height, by making the centre portion of the chandelier telescopic. Such a telescopic inlet for air is shown at Fig. 35; a similar telescopic inlet, but formed as a pillar instead of being suspended, is shown at Fig. 36. At the same time, I may in addition use other

Fig. 35.

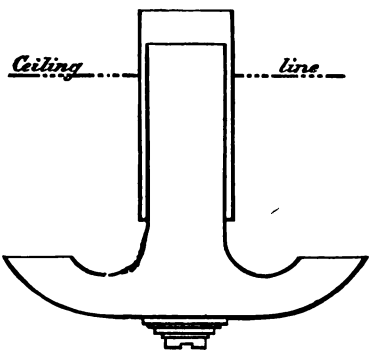
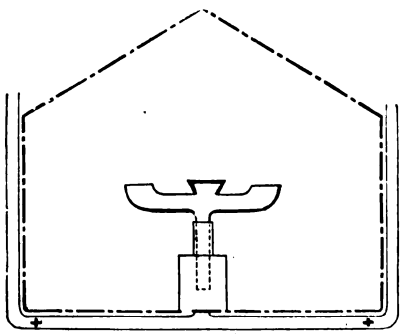



Fig. 36.



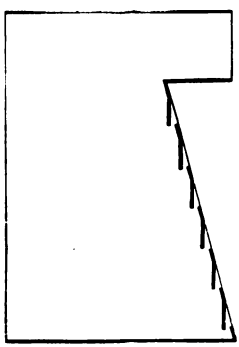
air inlets at the sides of the room, as now usually provided, so that while by the arrangements hereinbefore described down draught in any room is avoided, the whole of the air in the entire space will be

made to diffuse throughout the room, and the benefit of fresh air will be observable in every part of it. The air outlets from the chandelier may be made bell-mouthed, to permit of the ready diffusion of the fresh air as it enters the room, and the diffusion of the air may be further promoted by carrying a button centrally above the outlets, as shown. In order to speedily and at all times derive increased benefit from the air inlets as above mentioned, I further set the air in the space to be ventilated in gentle motion by exhausting a portion of it by the action of the wind upon a ventilating cowl fixed above the roof, as before described, or by the action of heat, as hereinafter described.

"In order also to vary at pleasure the height of the outlet openings from which vitiated air is drawn off from a room, I employ similar telescopic apparatus, either suspended or as pillars.

"For the mere purpose of facilitating the escape from a room of an excess of heated, or otherwise vitiated air, for which the Arnott, Boyle, and other so-called 'ventilators' have hitherto been chiefly used, whether the valves were made of thin iron, balanced, or of mica, cork, or oil-silk, or other material balanced or suspended, I reverse the mode of applying or placing them, and, instead of placing them so that in their normal position they are always closed, I place them so that in their normal position the valves are always open, as shown at Fig. 37, and so that in the event of the current of air setting through them into the room, the valves, of whatever material they may be made, immediately close, in whatever position in the room they may be placed.

Fig. 37.



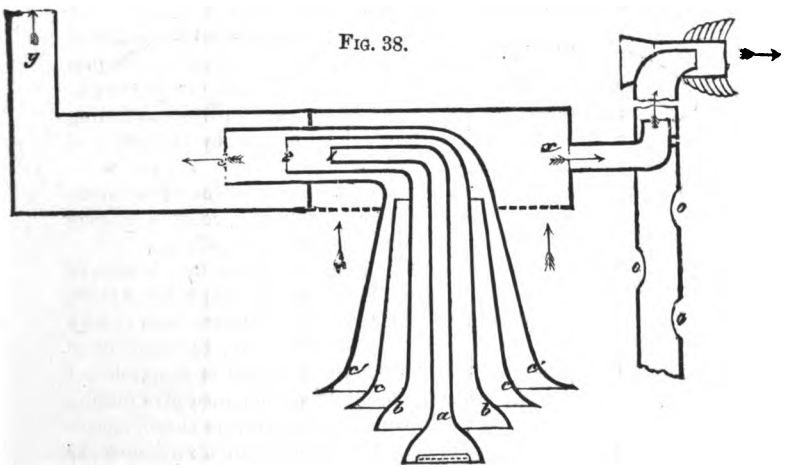
"For the purpose of ventilating a room by withdrawing vitiated air from it by the aid of heat, the arrangement shown at Fig. 38 may be used.

"A gas burner is at the bottom of the smallest or inner tube *a*, the tube is led through above the ceiling of the room or building into and through a chamber *x* above it, and terminates at the point 1. The next larger tube *b* terminates at the point 2; the next larger, if there be one, at the point 3, and so on.

"To further increase the exhaust effect, I may place a circular

gas burner round near the bottom of the smallest tube *a*, at the point *b b*, so as to heat the cylinder or plate of iron or other material between *b b* and *c c*, and another in a similar way, if desired, to heat the cylinder or plate between *c c* and *c' c'*. All these tubes lead first

FIG. 38.

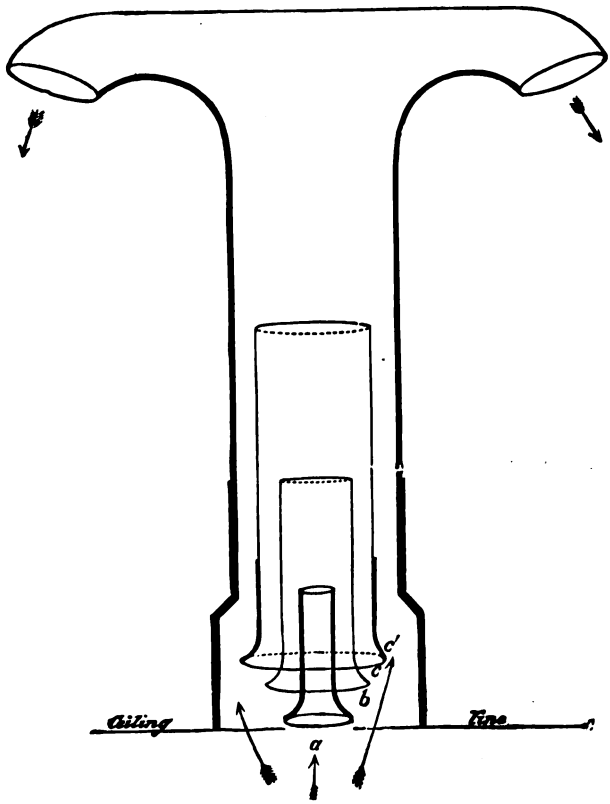


horizontally into an air flue, which is afterwards carried vertically to above the roof, and has an exhaust cowl mounted upon it. The air chamber *x* is closed except at its lower side, where a grating in the ceiling around the tube above described admits hot air from the room into it; from this chamber a separate flue, as shown in Fig. 38A, is led first horizontally and afterwards vertically to above the roof, and has an exhaust cowl mounted upon it to exhaust the hot air from the chamber *x*, and consequently from the room below it, and may be further used to draw air from the same or adjoining room, as shown, and by openings at *o o*.

"If the arrangement is to be used for ventilating only a sewer, or drain, or any large space, I dispense with burning gas below or within the innermost tube for light or otherwise, and make it much larger to cause a large draught from the sewer, drain, or other place to be ventilated, and in which gaslight is not required freely through the inner tube as well as in like manner through the outer area *c' c* of the large cylinder; and I utilise in like manner, as shown above, the increased speed of the burnt air as an additional exhaust force

to withdraw the foul, vitiated, heated, or other air from the sewer, room, or place to be ventilated, besides the effect which for the same purpose the heating of the plates or cylinders between *b b* and *c c*,

FIG. 38A.



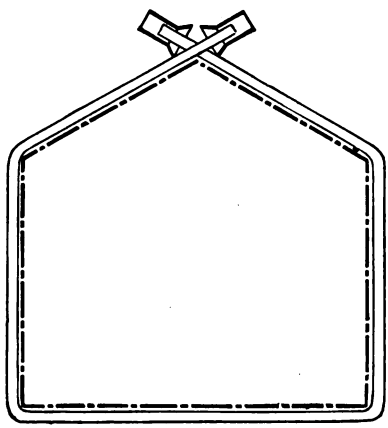

and between *c c* and *c' c'*, and so on *ad infinitum* will produce.

"In ventilating a sewer my object is to render openings into it from the street or roadway much less frequent than is now found

necessary. In addition to the increased exhaust force to be created and continually kept up by the arrangement above described, I afford one large inlet at any convenient place, preferably at the head of the sewer, for fresh air to be drawn freely into and constantly through the sewer, such large inlet being in any case at a much greater distance from the exhauster than has hitherto been found practicable by the usual mode of constructing furnaces in ventilating shafts erected or used for that purpose. Instead of using gas as the heating power, proper arrangements are made, as shown at Fig. 39, for the use of coal, coke, or other suitable material; the fire-grate is, as shown, of an annular form, and a current of air passes up through its centre and also around its exterior.

"In cases where the drain is at two sides of the roof of a house, I carry the shafts to just above the ridge on each side of the roof, and fix the ventilating cowl, as shown at Fig. 39A, so that when the wind

FIG. 39A.



makes the one cowl an exhaust, the other (whether near or fixed the opposite way in another part of the building) becomes an inlet, so that from whatever point the wind blows the fixed cowls produce useful effect.

"For the purpose of facilitating in a cheap and effectual manner the thorough ventilation of any shaft, sewer, soil, drain, or other

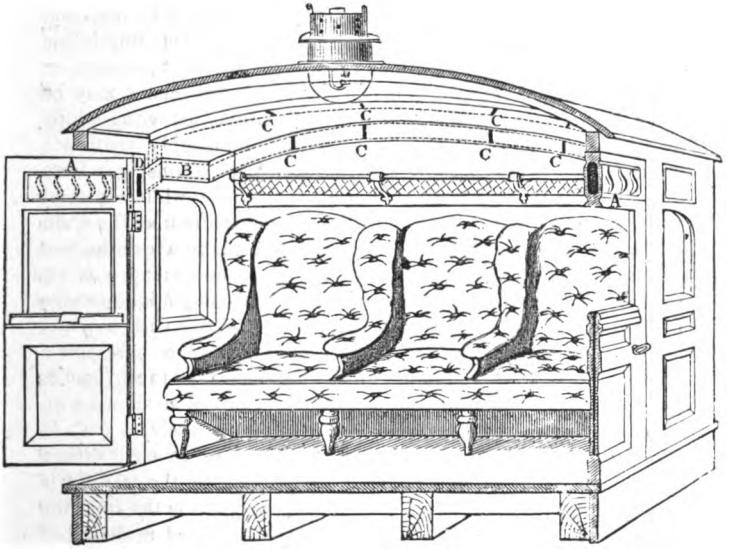
pipe or shaft connected with the house or building to be ventilated, and yet allow all impure matters to pass unperceived from the house as well as through the ordinary channels outside it to reservoirs provided for their reception near or at a distance from it, I place near the basement a trap formed as shown at Figs. 6, 7, 8.

"The traps may be made of stoneware, porcelain, iron, or other suitable material. They may be used inside or outside a house, and may be placed below, upon, or above the floor or ground level; they are made with flanges, or with sockets, and being inexpensive, and having ready means for inspection and cleansing, may be used at the bottom of rain-water pipes and for scullery sinks, and being thoroughly ventilated, instead of open disconnections for bath, lavatory, and other sinks, and used for the soil pipe, with inlet and cowl, as set forth in former patents granted to me. One trap in the basement will suffice for several closets, and all D, S, siphon, or other traps usually placed immediately below each closet may be most advantageously and with perfect safety dispensed with; while, by their use, the house drain may be also thoroughly ventilated through them, thus forming a second safeguard against gas from the sewer, drain, or soil pipe entering the house; while the total cost is considerably reduced by zinc ventilating shafts from the drain and from the top closet for the soil pipe upwards to above the roof instead of lead. In the trap shown at Fig. 6 the opening *a* is for an air inlet to soil pipe or for rain water; the opening *b* is to receive the soil pipe; and the opening *c* is to be covered with a plate, readily removable, for inspecting or cleaning the trap, or to receive a shaft for ventilating the drain. In the trap shown at Figs. 7 and 8, the opening *a* receives the soil pipe, which is formed as shown with an inlet for air or rain-water; the opening *b* is to receive a shaft to ventilate the drain; and the opening *c* is to be covered with a plate, readily removable for inspecting or cleaning the trap; *d* is the dip plate within the trap. An inlet to and the outlet from the trap may be made horizontal. The means hereinbefore described for ventilating rooms are also applicable to ventilating ships and vessels."

With regard to railway carriage ventilation, as the air within the carriages of the Underground Railways is always hotter and more noxious than that in the tunnels, this evil might be greatly diminished by the carriages

themselves being ventilated, which is not now the case. To remedy this defect, I close up the bottom of the hood which is generally placed outside at the top of the carriage door, and make a small hole or two in the bottom to allow rain or water to escape, if any should get in. The space covered by the hood is extended an inch or two within the carriage, which space—as at A in the drawing (Fig. 40)—I call the accumulator. From

FIG. 40.




the accumulator inside the carriage, I lead flat rectangular tubes B, which may be made to terminate at different points within the carriage, or have their ends left open along the sides and backs as well as along the ceilings or roof. In these tubes, or in the accumulator itself, I make slits or openings C at various points

from which it may be desired to draw the smoke or the vitiated air from within the carriage. This may be regulated by simple valves, and fresh air may be admitted into the carriage at any desired point when all the doors and windows are closed. I also make a number of slits or openings of an S form, with the sides projecting a little beyond the face of the carriage outside of the hood, or at any other parts on the outside of the carriages; and the motion of the carriage through the air causes (by means of the inclined planes forming the ventilators) an induced current of air through them from inside the carriage.

In an article published in *Iron*, which gives a good description of my method of railway carriage ventilation, it is stated in favour of this invention:—

"We have examined a model of the proposed ventilator, and by passing a current of air across its face, an induced current was created which effectually drew smoke from within the tube, and discharged it into the outer atmosphere. Here then is a very simple remedy for the thousands of badly ventilated vehicles, which daily traverse our railways, and indeed our streets."

The *Railway Supplies Journal* also states in its favour:—

"Mr. E. G. Banner's new method of ventilating railway carriages possesses some novel features which ought to render it extremely popular with the public. The ordinary ventilators, as employed in railway carriages, are hardly worthy of the name. They are at best merely openings over the doors or windows, and on a windy day they create an unbearable draught, while in sultry weather, or in passing through tunnels such as those on the Underground Railway, they are practically useless. These evils Mr. Banner completely remedies and by a very simple method which utilises the present inefficient attempts at ventilation, and consequently renders the new method extremely inexpensive. . . . The merits of this simple device are obvious. It really will supply fresh air within

the carriage regardless of the state of the atmosphere, and however still the air may be outside it practically causes the ingress of as much fresh air as is wanted, and draws hot and vitiated air from the various nooks and corners which generally remain entirely unventilated and impart to the carriage a stuffy and most unwholesome smell. Though the air on our underground lines is very bad, it is at least better than that to be found in what really at present are *unventilated* carriages, each crowded with passengers, and heated to boiling point inside, by four or more gas burners or lamps, with all doors and windows closed. Mr. Banner's system can be adapted to the existing carriages at a very small cost, a great consideration to railway companies, who are often deterred from adopting new inventions by the loss that would accrue through discarding a quantity of existing stock. Indeed, the system is so cheap that its adoption on an extensive scale would entail comparatively very little expense, while the comfort to the passenger from a good system of ventilation is almost incalculable, especially in the height of summer when trains are crowded with people, as well as in winter, when the smoker who has his back to the engine asks his opposite neighbour to allow the windows to be down, which, and not unreasonably, he decidedly objects to; and the companies would do well to remember that during hot weather a very large number of people on suburban lines revert to the ancient 'knifeboard' of an omnibus, at the cost of a little time, rather than be half suffocated by bad air, and an insufficient supply even of that.

"Models of Mr. Banner's invention may be seen at his offices in Billiter Square, E.C., where any particulars regarding the price or application of the system can be readily obtained."

I will now draw the attention of my readers to the application of my system to the improved ventilation of the Council Chamber, Guildhall, a report of which appeared in several scientific journals in March 1880.

I must first state what the conditions as regards the ventilation of the Council Chamber were when I first saw it. Practically it was almost hermetically sealed: as there was no fireplace there was consequently no chimney, and there was no outlet from the dome into the double lantern light. The only intended outlets

were the small opening above the rosette in the centre of the ceiling, over the Lord Mayor's chair, and the large long horizontal tube from the sun-light in the dome, which were both carried into one large vertical shaft, commencing above the former. The second large shaft, that over centre of gallery annex. put up in July 1878, afforded, like the other, no relief—valves, cones, and burners had to be put into both to prevent down draught. The only windows are close to the ceiling at each side of each annex, and could only be opened with impunity in hot weather. Besides the sun-light which passes through the centre of the lantern light there were eight gasaliers burning all day. Thus the Chamber was almost hermetically sealed, for practically there were neither inlets nor outlets for air; and by the time that from 200 to 300 persons had been in it for an hour or two, the atmosphere became very bad indeed, and these conditions are said to have resulted in very general and serious complaints from all those who were long present, and in many, in suffering from what was called "a Council Chamber headache," and there existed no real means of obviating this unpleasant state of things.

Since the alterations which I have made have been in operation, I am informed that no one has suffered from "Council Chamber headache." Repeatedly, in the early autumn, with the thermometer outside between 59° and 64°, when the system I have applied was allowed full play, the temperature within the Chamber never was more than two degrees above the external temperature, though 200, and sometimes nearer 300 persons were constantly in the Chamber for several hours together. What, I ask, can be thought of such a

result, produced entirely as it is from the system I have introduced, when I see it certified in 'Sanitary Engineering,' p. 107, by that well-known authority, Mr. Bailey Denton, that "in a room 13 by 15½, and 10½ feet high, after three hours, the temperature, 9 inches below the ceiling, rose 17½°, and at 5 feet below the ceiling 15° above the temperature recorded before doors and windows were shut, with a fire, three gas-burners, and only two persons present"? A room of the dimensions given is equal to an air-space of about 2100 cubic feet, and two persons present gives over 1000 cubic feet of air-space for each. The Council Chamber is about 60 feet long, 30 feet wide, and 32 feet high (encompassed almost wholly by outside walls), giving a clear air-space—furniture, &c., deducted—of about 50,000 cubic feet, which for 250 persons gives to each an air-space of only 200 cubic feet. To keep, then, the temperature of the Chamber within two degrees of the external temperature in summer, is, I assert, a feat in ventilation which has never before been approached. A change occurs in the state of things, and we have an unprecedentedly severe winter to deal with. It must be borne in mind that I was asked to ventilate, not to warm the Chamber, though what I have done facilitates the latter, inasmuch as the warm air is now drawn from the coils into the Chamber, instead of being left to leisurely find its way there.

The existing warming power was, and is, unquestionably very deficient, being about one-third only of what it ought to be, viz. 334 feet of 3-inch pipe, instead of 2100 feet of 2-inch. With the external temperature at or about 35°, and the temperature within the Chamber raised by the animal fires of 200 or 300 persons

to 70°, that there is a great rush of cold air into the Chamber through the door, whenever it is opened, cannot surprise any reasonable person who will fairly consider the matter. 70° within any chamber means a large vacuum, if the atmosphere outside it be only, or near 35°; it should be borne in mind that air rushes into vacuum at the rate of 1329 cubic feet per second. On one occasion when I was myself at the Council Chamber, the temperature outside was 40°; inside the Chamber at 12.15 the thermometer registered 55° (the furnace to heat the existing coils had been alight about six hours); at 2 o'clock it registered 60°, and at 5.30 it was only 64°, though over 200 persons had been in it for about six hours. It is calculated that one man heats 777 feet of air 1° per minute. Here again I claim to have accomplished a feat in ventilation, and this in winter with nearly all the inlets for fresh air closed (as windows are closed in cold weather), with a sun-light and several gasaliers kept alight the whole time, without even a fireplace and chimney to assist, as they do in most rooms, to alleviate the most unhealthy state of things brought about in any unventilated room with some 200 persons present.

When the inlets for the admission of fresh air are nearly all closed, then the only means for its admission is the door, which is full 8 feet high and nearly 5 feet wide, a superficial area of about 40 feet, while the whole superficial area of the twenty-three inlets provided by me does not exceed 8 feet, and nearly all of them, as I have said, were closed on the occasion I refer to.

It is perfectly well known that, before I did anything, great draughts—down draughts as they are called—were complained of, and that the same are still at times complained of is not chargeable to me. I must not omit

to mention, as very noteworthy, especially for those who complain of down draught, that the total length of the interstices round the inlets which are provided within the Chamber (when the valves in them are closed), and at which cold air could possibly enter, does not amount to what of necessity exists round the frames of the windows of very ordinary size, for an ordinary-sized room.

Let me now call attention to the fact that when the door of the Council Chamber is also shut, almost the only means left for fresh external air to enter it is through the gratings in the floor for warmed air. I had the grating which admitted the impure air of the basement into the hot air chamber closed.

When the hour of meeting in the Council Chamber arrives, it is usual to let the fire out in the furnace, but during the most crowded meetings it is customary to keep the gasaliers burning. They, of course, consume a considerable amount of fresh air; owing to the very insufficient warming power, it may be advisable to use these gasaliers to warm the Chamber before the time of meeting, but surely their being kept alight afterwards cannot fail to unnecessarily heat and vitiate the air of the Chamber when there are 200 or 300 persons in it.

It is authoritatively stated that carbonic acid gas, being so much heavier than air, rests mostly near the floor-level, and this was my reason for putting the extra shaft X, Figs. 41 and 43. If even the seven exhaust cowls from the ceiling overpower it, it serves the better to diffuse fresh air drawn from the roof throughout the whole space, with which object I put the inlets, Nos. 15, 16, 17, through the floor, and when these are not required for the Council Chamber, this shaft may be used to effectually ventilate the "Records" below it.

To people variously interested in the working of any

system, an inventor or innovator is scarcely ever a welcome personage, and is often considered one who must be kept at arm's length.

I cannot of course hope to satisfy every one in a body of 200 or 300 persons; a few out of the number may complain that they are subject to a draught, others that they are too hot, but the great majority, including the officials who are always present, will I feel sure admit, not only that the atmosphere within the Chamber is greatly improved, but will go further and say that it is now capable of being kept comfortable, healthy, and as it should be.

If it really be thought by the members generally that what I have done to improve the ventilation of the Council Chamber is detrimental in any way to their health and comfort, I have provided the means, by valves at every point, of most effectually rendering the whole, temporarily or otherwise, entirely inoperative at any time in less than ten minutes, and thus to make the Chamber what it was, as regards "ventilation," before I did anything to it. I unhesitatingly say, however, provided intelligent application be made of the means now existing, the Council Chamber is the best ventilated room in the Guildhall or elsewhere. I may also mention that since I inaugurated this novel mode of ventilation, the Hall of the Royal Institute of British Architects has been ventilated on almost identical lines, so far as the application of general principles is concerned; and even there, under certain modifications in other respects which I feel certain are prejudicial, the result is I hear considered "splendid ventilation." Complaints of draughts at the inlets were at first made by some of the members, but these I believe have ceased since the inlets have been heightened and

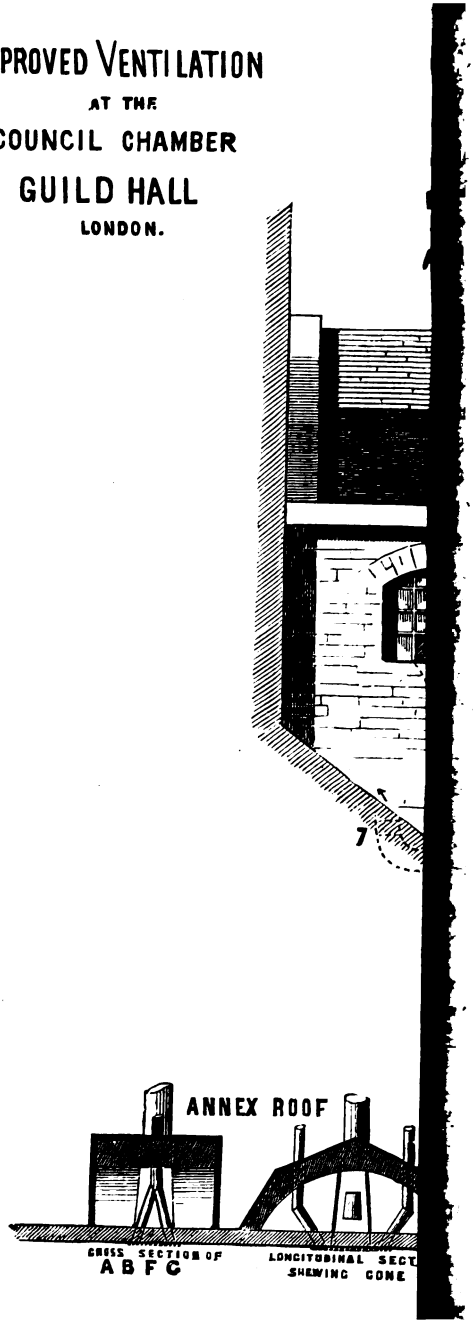
# IMPROVED VENTILATION

AT THE

## COUNCIL CHAMBER

## GUILD HALL

LONDON.



valves put into them to regulate the supply, as varying circumstances render necessary without closing their external orifices.

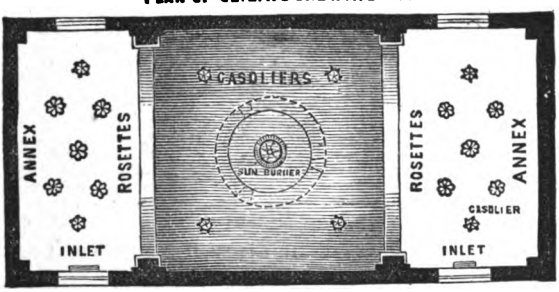
With the aid of the accompanying drawings and plans, &c., I will now proceed to explain the alterations I have made, and state the results obtained by them.

The system depends mainly on the efficient action of the exhaust ventilators, combined with the judicious arrangement of proportionate inlets for fresh air, placed at various proper positions in the space to be ventilated. The exhaust power of the ventilators varies with the velocity with which the wind passes through them. The average, accelerated by cones and burners, may be reckoned as about 300 feet per minute.

By experiments lately conducted at Hove, a given volume of air passed through a Banner cowl, at various velocities, was found to create an induced current on an average of careful tests of over 26 per cent.

Fig. 42.

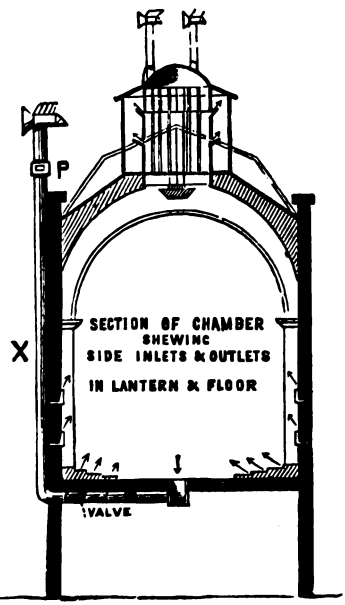
PLAN OF CEILING SHEWING OUTLETS




I have placed above the roof eight 14-inch Banner cowls on suitable shafts, in each of which the sectional area for egress of air is about one square foot, giving a total of about 1200 inches. Seven of the exhaust ventilators withdraw the air at the ceiling, and one of

them, X, from the floor, through the previously existing gratings. This latter, in winter, when warmed air is required, will, by a valve for the purpose, be inoperative, but can then be used to ventilate the "Records," while in summer it may also be readily made to supply fresh air to the Chamber from above the roof. The seven

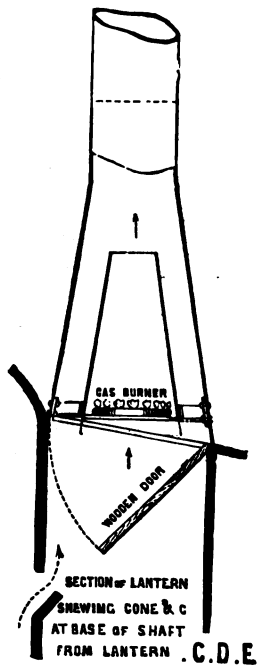
FIG. 43.




from the roof are placed one at each end of each annex, each drawing from above two rosettes in the flat ceilings; the other three are carried from the space between the double lantern *above the dome*, into which there are seven outlets from the Chamber, each being 17 inches long and 5 inches wide, in two tiers—three in the upper and four in the lower tier. At the base of each shaft

is a wooden flap or door, which on being closed renders the cowl mounted upon them completely inoperative, while, if the wind be insufficient, there are cones and gas-burners just above the wooden doors, which, when lighted, will very greatly increase, as you will notice by the annexed tests, the current of vitiated air from the Chamber. I may mention that these cones and burners are not a mere flame in the centre of a large shaft, as was sometimes previously put, serving for little more than to show the air the way in such shafts when it was inclined to go either up or down them. These shafts are lettered in the plate, Fig. 41, A to G and X, and the doors, valves, cones, and burners are shown in section, as well as the double lanterns, &c.

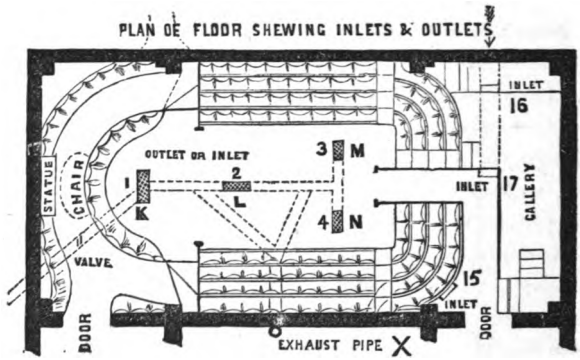
Fig. 44.




The plate also shows the inlets for fresh air, which are placed at twenty-three different positions within the Chamber, each of which is numbered 5 to 27. There are ten on each side of the Council Chamber and three, 15, 16, 17 (Fig. 45), from the floor. These latter are so placed for the purpose of obtaining a more thorough diffusion of air in the whole space, which object is further promoted by the gratings 1 to 4 in the floor, whether warmed or fresh air be drawn in thereat. The total superficial area

of inlets is about 1650 inches, or about one superficial inch for every 30 cubic feet of clear room space. The whole may be entirely closed at pleasure by

Fig. 45.




means of valves provided, or they may be regulated as the number of persons present, or as the velocity of the wind, or the external temperature, may render desirable. There is a clear air-space in the Chamber of about 50,000 cubic feet. The result sought to be worked out by the foregoing arrangement, which is suitable for all public buildings and large rooms, is that at less than the average velocity of the wind the air within the Council Chamber may be imperceptibly renewed about three times within an hour, thus—

| | | |
|---|---|---|
| Per minute .. .. .. .. .. .. .. .. | 300 | feet. |
| 1 ventilator 1 foot; No. of ventilators .. .. | 8 | |
| | 2400 | „ |
| Each 20 minutes .. .. .. .. .. .. | 20 | „ |
| (Sun-light, &c.) | 48,000 | „ |

Gratings in floor for warmed air from coils or for fresh air from roof; which may be used also as outlets at floor-level, are shown at Fig. 45.

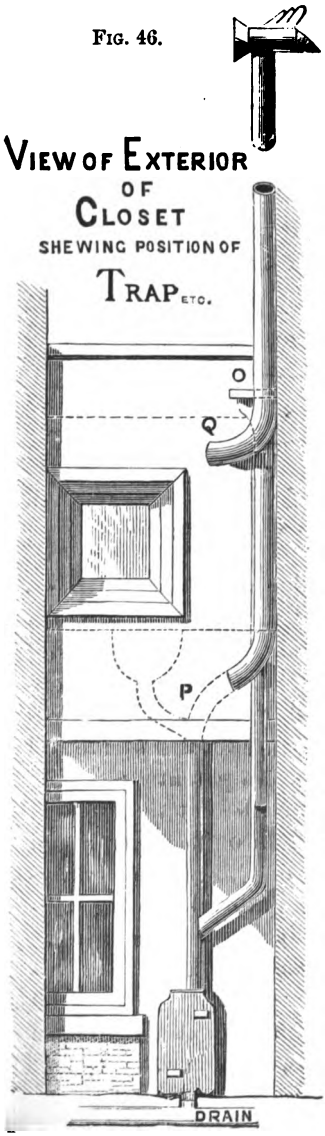
| 1 | 2 | 3 | 4 |
|---|---|---|---|
| K | L | M | N |

Inlets for fresh air, covered externally with perforated zinc, and fitted with valves inside to prevent or regulate the supply.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| South side, | 5, | 6, | 7, | 8, | 9, | 10, | 11, | 12, | 13, | 14 |
| Each | 24 × 2½ | | 18 × 4 | | | | | | 12 × 6 | |
| North side, | 18, | 19, | 20, | 21, | 22, | 23, | 24, | 25, | 26, | 27 |
| Through floor in gallery annex, | | | 15, | | | 16, | | | 17 | |
| Carried up about 5 feet .. | | | 14 × 4 | | | 10 × 4½ | | | 15 × 4½ | |

Fig. 46 represents the soil pipe and closet arrangement. O is the head of a 3-inch rain-water pipe, which serves also as inlet for fresh air to the 4-inch soil pipe, a little above the double dip trap. P is an elongation of the soil pipe from just below a Pearson's trapless closet. From the point Q the continuation of the soil pipe upwards, and on which is fixed a patent ventilating cowl, is 6 inches, and by this arrangement the room in which the closet is, is ventilated through a perforated zinc grating placed at the base of Q, near the ceiling-level. The trap admits of the drain also being ventilated through it without exposing even for a moment any impure matter, an advantage of the utmost importance, as any one can learn by reference to page 60 of that admirable little work 'Sanitary Arrangements for Dwellings,' &c., by W. Eassie, Esq., C.E.

FIG. 46.




## RESULTS OF TESTS.

17*th Oct.* 1878. — External temperature at 3.10, 58½°. Temperature in Chamber:—

| | | | |
|---|---|---|---|
| At 11 A.M. | .. | .. | 59° |
| „ 4 P.M. | .. | .. | 64° |

Four of the gasaliers and the sun-light burning all day.

Velocities per minute in outlets from *inner* lantern 17 × 5 inches:—

Upper Tier.

| No. | 1 | 2 | 3 |
|---|---|---|---|
| | 244 | 332 | 260 |

Lower Tier.

| No. | 4 | 5 | 6 | 7 |
|---|---|---|---|---|
| | 341 | 378 | 354 | 366 |

Velocities up cowl-shafts from lantern:—

200 240 300

24*th Oct.* 1878. — External temperature at 12, 59°; the room was full; meeting ended at 3.15.

Thermometers at:—

| | Lord Mayor's Chair. | Princes' Bust. | Princess's Bust. | Gallery. |
|---|---|---|---|---|
| At 11 A.M. .. | 60° | 60° | 60° | 60° |
| „ 1 P.M. .. | 61 | 61 | 61 | 62 |
| „ 3.30 „ .. | 62 | 60 | 60 | 61 |

Velocities in outlets from *inner* lantern:—

| | Upper. | | | Lower. | | | |
|---|---|---|---|---|---|---|---|
| At 1 P.M. .. | 460 | 620 | 390 | 484 | 560 | 550 | 526 |
| „ 2 „ .. | 510 | 440 | 530 | 598 | 610 | 450 | 612 |
| „ 3.15 „ .. | 230 | 286 | 194 | 350 | 380 | 406 | 330 |

The gas-burners in cones at base of shaft, from space between the two lanterns on which cowls are fixed, were put out at 2 o'clock. Mats were covered over the gratings in the floor; inlets all open.

2*nd Nov.* 1878.—External temperature at 10.30, 42°.

| | Inside Temperature at | | | | |
|---|---|---|---|---|---|
| | 11 | 12 | 1 | 3 | 5.30 |
| At Lord Mayor's Annex .. .. | 56° | 58° | — | — | 64° |
| „ Prince's Bust .. .. .. .. | 52 | 54 | — | — | 58 |
| „ Princess's „ .. .. .. .. | 53 | 51 | — | — | 56 |
| „ Gallery Annex .. .. .. | 55 | 58 | 61° | 61° | 62 |
| „ Chamber thermometer .. .. | 55 | 56 | — | — | 63 |

| | 11 | 12 | 2.30 | 3 | 5 | 5·30 |
|---|---|---|---|---|---|---|
| In Lantern Light *above dome* | 57° | 61° | 60° | 62° | 64° | 65° |

The furnace was lighted at 6 A.M.; four gasaliers and sun-light burning. Most of the inlets were closed, and only four of the exhaust cowls open up to 12 o'clock; at 12 o'clock opened the other three cowls; at 1.15 lighted the gas-burners in cones in shafts from lantern, and in centre shafts of both annexes; at 1.30 six of the inlets opened; the gasaliers were put out; at 2.30 some complained that the chamber was cold when the burners in all the cones in lantern were extinguished, and two of the exhaust cowls from same were closed. The usher had been altering the inlets during the meeting, which was a crowded one.

12*th Dec.* 1878.—External atmosphere about 32°. The meeting was a full one, and a long one, from 12 to 5.15. An official, whose seat is near the centre of the Chamber, at 3 o'clock, said the temperature was very agreeable, and neither too hot nor too cold. There was but one complaint all day; it was at 1 o'clock, that it was rather warm. At 10.30 three of the exhaust shafts were closed, and all the gasaliers were alight.

| | The Temperature at | | | | | |
|---|---|---|---|---|---|---|
| | 10.30 | 12 | 1 | 2 | 3 | 5.15 |
| Lord Mayor's Annex .. .. | 52° | — | — | — | — | 61° |
| Princess's Bust .. .. .. | 49° | — | — | — | — | 54° |
| Prince's „ .. .. .. | 50° | — | — | — | — | 56° |
| Gallery .. .. .. .. | 56° | 58° | 64° | 66° | 65° | 64° |

We only had access to the gallery during the meeting. At 2 o'clock all the exhaust shafts were opened, and then the gas-burners in those from lantern were lighted, and afterwards no complaints whatever were heard; in the gallery we found the temperature very agreeable.

| The temperature in the space between the two lanterns was— | | And in the dome about ceiling-level in the vicinity of the sun-light— |
|---|---|---|
| At 11.30 .. .. | 56° | 70° |
| „ 1 .. .. | 62 | 74 |
| „ 2 .. .. | 66 | 77 |
| „ 3 .. .. | 66 | 76 |
| „ 5 .. .. | 68 | 76 |

13*th March*, 1879.—External temperature about 38°. The Council broke up at 4.30, the thermometer then stood at 64°; there were no complaints all day. The thermometer in lantern at 4.30 was 68°. The one hanging down from it at about ceiling line 67°.

27*th March*, 1879.—External temperature 40°. One of the aldermen who had carefully noticed the temperature of the Chamber, told me that at 12.15 it was 55°; at 2 it was 60°; at 5.30 it was 64°; and said the atmosphere was satisfactory all the day.

Since writing the above I have received the following. While the one is confirmatory of the foregoing report, the other is in direct contradiction to the results said to have been obtained by the cowl tests as conducted at Kew, and after which the "Sham Usefulness of Cowls" was so persistently advertised, to the serious damage of a most important industry, as well as to the great detriment of the interests of the community at large. Almost every house in every town in the kingdom bears silent testimony to some great error in the conclusion arrived at.

"ST. MICHAEL'S, CLAPHAM RISE, *February* 1880.

"SIR,—I have the pleasure to enclose cheque in discharge of your account. Rayfield has done his work to our entire satisfaction. With regard to the success of the cowls it is difficult to speak with absolute certainty in the present almost dilapidated state of the church; that they do most thoroughly sweep and cleanse the church of the vitiated atmosphere which used before to poison me well-nigh to the death every Sunday, there can be no manner of doubt; the only question is as to their effect upon the draughts, some thinking that they have increased these, while others (and these latter the best judges) are of opinion that they have considerably diminished them. I hope we may see our way to having the inlets made, and then I shall be able to let you know exactly and fully what we think of your simple, and yet admirable and clever invention, to which I wish all possible success.

(Signed) "M. F. BEGBIE."

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"HOVE, BRIGHTON, *February* 11, 1880.

"SIR,—I enclose you copy of notes of the experiments made here with your patent cowl. They show conclusively that a given volume of air passing through the annular portion of the cowl at a velocity of 18·72 miles per hour, will draw through the inside pipe another volume of air which is equal to 29·12 per cent of the first-mentioned volume.

"Yours faithfully,

(Signed) "J. B. PADDON.

"DETAILS OF EXPERIMENTS MADE WITH BANNER'S PATENT COWL.

"*January* 31, 1880.

| | Placed in Outlet Pipe of Air Vessel. | Placed One Inch from Outlet Pipe. | Placed Six Inches from Outlet Pipe. | Placed Nine Inches from Outlet Pipe. |
|---|---|---|---|---|
| | revolutions | revolutions | revolutions | revolutions |
| An Anemometer recorded per minute .. .. .. | 820 | 716 | 420 | 200 |
| Equivalent to a velocity in miles per hour of.. .. | 18·63 | 16·27 | 9·54 | 4·55 |
| Air delivered into hopper-mouth of Cowl, an Anemometer placed at the inlet of inside pipe of Cowl recorded .. .. .. .. .. .. | | 180<br>160<br>220 | 110<br>130<br>136 | 53<br>53 |
| Average .. .. .. .. .. .. | | 186·6 | 125·3 | 53 |
| Percentage on first-mentioned volume | | 26·06 | 29·8 | 26·5 |

"The pressure of air throughout the above experiments was equal to 1·75 inches of a column of water, and was varied by distance from outlet pipe. During the delivery of air under above conditions into the hopper-mouth of the cowl, the variations in the revolutions per minute were caused by alteration of the position of centre of cowl.

"*February* 7, 1880.—Air was discharged into hopper-mouth of cowl through a hole in disc fitted over it. All the following experiments were made under precisely the same conditions, except as to initial velocities, which were varied by different pressures.

"The results are shown in the following table :—

| | Velocity of Air in Miles per Hour. | Revolutions per Minute of Anemometer placed at Mouth of Cowl. | Revolutions per Minute of Anemometer placed at Inlet of Inside Pipe. | Rival Percentage of Air drawn through Inner Pipe upon Air passed into Mouth of Cowl. |
|---|---|---|---|---|
| No. 1 .. | 30 | 1320 | 420 | 31·82 |
| „ 2 .. | 18·72 | 824 | 240 | 29·12 |
| „ 3 .. | 13·77 | 606 | 154 | 25·41 |

"Thus, it is guaranteed that if the wind at roof-level be blowing at four miles an hour, which is only about one-third its average velocity, that fresh air is drawn in at the inlet, if it be properly arranged, and out by the cowl through any house drain or soil pipe in less than one minute.

"Nature has a sensible habit of supplying her wants from the nearest point. When this fact is borne in mind it will not be difficult to satisfy ourselves that mere louvres, screws, and fans, however scientifically placed and guarded, cannot draw or force still air into a heavier atmosphere in motion, and which is pressing for admission at every turn or crevice all round them."

As already mentioned at page 76, my system of ventilation adopted at the Council Chamber at the Guildhall as thus described, was very closely imitated if not actually duplicated at the Hall of the Royal Institute of British Architects in 1879, and last year the London Custom House was ventilated upon a similar plan. The chief or only difference between the three plans, was the employment of different *ventilators* in the hope of producing as good an effect, but this, as yet, remains an open question upon which each one of us must be permitted to exercise his own common sense as regards the main facts.

As proof not only of the indifference to, but of the neglect of, ventilation in public edifices, as well as in all private dwellings, it may be stated that prior to the improvements effected at the three important rooms as stated above, there was really no attempt at ventilation in either of them. At the Custom House the room is one of the largest in London, and before the late alterations were made, when the doors were closed, it was practically, in winter, a hermetically sealed space, with two large stoves on the floor dependent for combustion on the vitiated air within the room, which being heated,

is again delivered into the room, more vitiated than before, with only the flues from these stoves, led under the floor of the room for the partial—very partial—relief of the hundreds of persons generally in it. Fortunately one or other of the three large doors (all of which were close together) were open, and the height of the room is very great—54 feet.

It is true that there were some small valves which might have been opened from the upper part of the room into the space between the ceiling of the room and the roof, but neither these nor the windows at each end close to the ceiling could in winter be allowed to be open, because of the great down draught caused by their being so. As stated at page 52 some alterations suggested by me since the improvement as already mentioned has been effected, have been adopted with great advantage, but others have yet to be carried into effect. I have no hesitation in stating that facilities exist at the Custom House for still further important improvements both for warming and ventilating it in winter, and for ventilating it in summer at comparatively a trifling cost.

The total air space of the room is over 600,000 cubic feet, about 12 times greater than that of the Council Chamber, and now there are 6 shafts, each 18 inches in diameter, carried to above the roof, for at least the escape of vitiated air, at the ceiling level, which cannot fail to be, as has been claimed for it, a very great improvement on the previously existing conditions. The cubic air space at the Council Chamber is about 50,000 cubic feet, and, as has been before stated, the shafts led from the ceilings there for improving the ventilation are in superficial area about 8 feet; at the Custom House,

where the space to be ventilated is 12 times greater, the total superficial area of the shaft from the ceiling is less than 14 feet; while the total of the inlets for fresh air at the Council Chamber is nearly 12 feet, at the Custom House the total superficial area of the same is less than 7 feet. After certain tests had been made of the improved system of ventilation at the Custom House, the Report states, that "the old system of ventilation was then put in operation and tested, the result being a strong down draught, which proved so annoying to those in the room underneath that they energetically signalled for the openings to be closed." Thus affording practical proof of the inefficiency of "the old system" under which there were no outlets of any kind from the ceiling of the room through the roof.

I have seen it stated that the alterations made at the Guildhall are a failure; if that were true, it would be difficult—I might say impossible—to show how the alterations made at either the Custom House or the Royal Institute of British Architects can be, as has been stated, "splendid ventilation."

In conclusion, I will add that from what I have stated in the new edition of my book, I have every reason to believe that the public will not only be thoroughly convinced that my reformed system is the most useful and beneficial, and on the whole the most inexpensive for the objects sought to be attained by it, but that I have a good moral as well as a sound legal title in my patents for such, as the inventor of what is now so well known as the "Banner system" of sanitation.

# APPENDIX

## OPINIONS OF THE PRESS, STATEMENTS AND TESTIMONIALS, ETC.

In a long letter recently published in the *Architect*, one of the correspondents of that journal, speaking of the Banner System of House Sanitation, "*a system at once so simple yet so effective*," thus describes it:—

"It is a tripartite system, consisting of, first, 'the trap'; secondly, 'the inlet pipe'; and, thirdly, 'the cowl.' The first unit herein is based upon one of the simplest principles—and one of the oldest known to us—that of the steel-yard; the second is something entirely new, when applied to the ventilation of drains or soil pipes. I say entirely new, because I hear and read that other sanitarians are claiming this innovation as something well known before. I go further, and say advisedly, it has never been applied in practice for the purposes to which the patentee has adopted it, nor was it seen before it was introduced to public notice at the patentee's house at Brighton, during the Social Science Congress meeting there in October 1875. Mr. Banner has very wisely secured it by patent, for without this inlet his cowl, or any other cowl, would be perfectly useless; the inlet being the lungs of the pipe or system, and the cowl the breathing power. This also illustrates another simple principle—the vent-peg in the barrel."

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"BANNER'S COWL FOR WITHDRAWING FOUL AIR.

(From the *Sanitary Record*, May 15th, 1875.)

"Hitherto, in the matter of simple ventilation, the great difficulty has been to light upon some ventilating medium which should absolutely remove all the contaminated air, and that steadily and in no intermittent fashion, as is the case with many highly lauded ventilators, which, however, are biassed in their action by the pre-

vailing wind. It has been usual, even in the case of the top of a soil pipe, to be content with a common funnel top, or a Tredgold pattern cap, but neither of these devices *withdraw* the foul air generated in the drains, but allow it simply to *escape* at *times*, more especially during *lulls* in the weather. The open-mouth revolving cowls are an improvement upon these latter contrivances, but still these behave far from satisfactorily, as the levitation of the gases is not mechanically assisted. *They are allowed sluggishly to accumulate in the ventilating tube* until the outer air permits them to find an exit. To remedy such evils Archimedean screw ventilators have been invented, and they perform excellent work in many situations, for instance, in cotton or woollen manufactories, where the withdrawal of the fluff in the air is desirable. And many other species of air-regenerators have been tried with more or less success for these and kindred evils.

"The difficulty, however, has been to provide a simple ventilator which, without unnecessarily forcing a change of air in a room and so creating a draught, should still readily act in quietly removing the stratum of air which has become unfit for respiration, and enable the room to be quickly filled with fresh air through the inlets provided for that purpose. The same beneficent result ought, of course, to follow its application to sewers and drains, and even vessels at sea. All that ought to be done by the workman should be merely affixing upon the top of the shaft the peculiar pattern of cowl which is the best adapted for the purposes sought, and the wind ought to carry out the rest of the contract. It is sufficient to say that a really effectual ventilating cowl would work equally well, whether withdrawing the air which passes up the soil pipe of a closet, pumping up the air from a general trap in the basement of a house, or retiring upon a larger scale the gases evolved by a main sewer; in the first case by dissipating the foul air through a four-inch pipe, in the second, it may be, by a six-inch pipe, and in the last-mentioned case by perhaps a shaft of two feet sectional area.

"The principle of Mr. Banner's cowl or foul-air withdrawer, and which is specially adapted for places such as we have described, is as follows. A revolving cowl is fitted upon the top of a foul-air shaft, and this is pierced both at back and front, the end best adapted for exit being always held to the direct current of air. The foul air naturally rises up the shaft, and from the simple blow-pipe action would at most times escape from the mouth of the

vane, because the wind would be blowing through the aperture at the back and assisting in its removal. But Mr. Banner has not been content with this idea of an occasional suctional action across the shaft, but has contrived a means of continuously extracting it under all the varying influences of wind and weather. *By means of this cheaply made and otherwise simple apparatus, the foul air in any shaft will be continuously extracted.* The invention is also adapted for use in churches or schools where a shaft would not be needed, but merely an opening at the ridge.

"Professional gentlemen who have to deal with sanitary questions have long been in search of a ventilator which could really be relied upon to perform, uninterruptedly, useful work under the circumstances which we have already enumerated; and we esteem it a fortunate thing for them, and, of course, for ourselves and the public generally, that it will, in future, only be necessary to specify the cowl now before us. The inventor, Mr. E. G. Banner, of Billiter Square, London, is well known to sanitary men as the inventor of what we cannot help terming *the best devised house trap in existence*, and to the history and working of which it is our intention to refer on an early occasion. Meantime let our readers who require foul-air withdrawers—as we have most uneuphemistically called them—try the Banner cowl. We have no doubt that in a very short time the name will be familiar in our mouths, and that the inventor—whom we understand, by the way, to have taken up the subject of sanitation on public grounds, and outside his own avocation—will do as much or more for health as Moore has done with glass *louvres*, Cooper with revolving panes, or the Boyles with mica flaps, and ridge, vane, and turret ventilators."

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## "BANNER'S SYSTEM OF SANITATION.

(From the *Architect*, November 20th, 1875.)

"Notes on Novelties.

"We have recently had an opportunity of thoroughly investigating the action of the sanitary appliances that have been patented by Mr. E. G. Banner, of 11, Billiter Square, E.C. The system adopted by Mr. Banner completely shuts out the sewer gas from the house, and is used *outside the house* to withdraw the gas from the drains and the sewer itself, and disperse it in the

upper atmosphere, far above the height at which it could possibly be injurious to human life. Mr. Banner's invention not only prevents all sewer gas from entering the house, but it also removes immediately the effluvia from the closets, and at the same time is made to thoroughly ventilate the whole of the pipes from the basement to the attics. We have no doubt that some sanitary reformers on reading the above statement will declare that such a result as we have described is impossible. Our answer to such objectors is—do as we have done, investigate and judge for yourselves. The illustration (see Fig. 1) will give some idea of the manner in which the novel plan introduced by Mr. Banner is effectually carried out. It will be seen that the system commences at the very bottom of the house, where the outlet to the sewer is thoroughly trapped, and that all other traps which are generally fixed to closets, bath, &c., can be dispensed with. The trap employed is entirely self-acting, and is always perfectly air-tight, the method of its construction proves that the flush must be complete under all circumstances, and it can be seen at a glance that it is absolutely impossible for it to become unsiphoned. The trap consists of a small air-tight chamber, A (*vide* description already given).

"A branch pipe E is led from outside the house into the soil pipe a little above the trap for the admission of fresh air, in order to admit, by the action of the patent cowl fixed on the soil pipe, carried above the roof, of a constant current of fresh air being kept up night and day, and during all weathers, throughout the whole of the pipes within the house.

"Mr. Banner demonstrates and proves conclusively that without such branch or inlet pipe for fresh air, no current *up* the pipes *can* take place, and he thus shows, according to the plan almost universally adopted hitherto, that all the pipes within the house do and must remain always fully charged with dangerous gases, even though the soil pipe be carried above the roof and be open, or what has hitherto been improperly called 'ventilated' at the top. *We may add that this inlet pipe is a most important and distinctive part of Mr. Banner's system, and forms part of his patent rights.*

"The efficiency of the trap thus formed cannot be destroyed by either pressure or suction, and entirely prevents any gas from the sewer getting up into the house.

"This excellent invention keeps up a constant ventilation of the shaft, in fact it makes it impossible for foul air to remain in the

shaft for a single second. The very instant the foul air is generated it is sucked up by the action of the cowl.

"It is noteworthy that while a mere breath of air passing through the cowl creates a sufficient suction action, that the wind in this country blows on average from 10 to 12 miles an hour throughout the whole year, and that when it is said to be 'still' the air is even moving at the rate of 1½ to 2 miles an hour.

"*We conclude by reiterating that we believe Mr. Banner's system of sanitation will make any house to which it is applied absolutely safe from the intrusion of sewer gas, or noxious odours of any description from the drains or closets.*"

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## "PATENT DRAIN TRAP AND FOUL AIR EXTRACTOR.

(From the *Builder*, December 11th, 1875.)

"In the course of our remarks on the recent Exhibition of Sanitary Appliances in Brighton, we alluded briefly to the trap and ventilating cowl invented by Mr. Banner. The subject, however, is so important that we think it desirable to enable those who are interested in the matter to understand more fully the patentee's views, and to judge for themselves as to their soundness.

"The patentee maintains the house will always be effectually trapped against sewer gas; and he is able to dispense with D traps, which from their conformation are, in point of fact, miniature cess-pools. One of Banner's traps at the basement of the house, which may be placed above the level of the basement, like a gas-meter, is considered sufficient for all the closets in a house.

"We must not omit to mention another valuable appliance devised by Mr. Banner. Every one knows that ventilating *shafts* communicating with the soil pipes are recommended by leading authorities upon the subject. Although the theory upon which they are constructed is good, they are not always of practical utility. There is a difficulty in getting sewer gas to ascend a long perpendicular pipe, *while in some conditions of the atmosphere there may be a down draught instead of an upward current;* and it is to overcome this that the cowl is introduced. The benefit that would result to the community from their general adoption would probably be great, as each would contribute to the ventilation of the sewers as well as of the pipes of the houses where they were fixed.

"A branch pipe, led from outside the house to a little above the trap, is needed, to cause a current of air in, and thus act as a constant ventilator of all the pipes between the trap and the cowl fixed on the soil pipe carried above the roof of the house. A separate pipe may, if thought desirable, be fixed into the chamber, and taken up above the roof of the house, to ventilate the sewer.

"These various arrangements have been in operation for two years in the patentee's house, and, as we are informed, and are prepared to believe, with undeviating good effect.

"*One lesson which Mr. Banner has learnt, and in his turn teaches the public, namely, that to make a ventilating pipe of constant avail air must be introduced at the bottom, is of itself a boon of value.*"

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## "BANNER'S SYSTEM OF SANITATION.

(From the *Metropolitan*, February 26th, 1876.)

"'Pure air,' says Mr. R. J. Halton, in one of his sanitary lectures, 'is the most important of all health factors. When it is breathed freely, plentifully, and continually there are few diseases it will not enable the body to resist.' Every medical man and sanitarian will admit the truth of this. Pure air will sometimes effect that which medicine attempts in vain, and when it is considered that 99 out of every 100 diseases are due to some impurity or other of the blood or secretions, it is evident that where fresh air can be obtained, medicine takes up an inferior position. As, however, pure air removes disease, so does foul air generate it. From the breathing of air vitiated by respiration spring phthisis and other pulmonary complaints, as well as typhus. But respiration is not the only form of air vitiation. The effluvia from cesspools and sewage are responsible for nausea, vomiting, diarrhœa, and enteric fever. Much has been said of late as to whether the water-closet and sewer system has increased the illness and mortality from these complaints, but for the present we may safely assume that the gases generated by the decomposition of fæcal matter, whether in D traps or others, cesspools, soil pipes, house drains or sewers, are undoubtedly injurious to health; and it is self-evident that the only thing to be done is to prevent their accumulation by dissipating them as soon as formed, and to exclude them *in toto* from our

houses. Many have been the attempts to effect this. Hitherto no sanitary authority has been able to adopt any method by which the thorough ventilation of sewers could be accomplished, and as regards the ventilation of soil pipes in houses, and the exclusion of sewer gas therefrom, that was considered, till recently, impossible.

"The public are tolerably well acquainted with the fact that Mr. E. G. Banner, who resides at Brighton, has introduced some inventions of his, *the object of which is to effect what has been described above as not previously accomplished.* We had the opportunity a few days ago of inspecting the ventilating and other apparatus in Mr. Banner's house, and spent several hours with that gentleman in inquiring into the practical and scientific details connected with them.

"As a trial of the ventilating contrivances, Mr. Banner's house is perhaps as good a specimen as could be desired. The trap in the basement acts perfectly, and thoroughly prevents the possibility of any gas passing from the sewer into the soil pipe. In order to ventilate this pipe, it was carried up above the roof of the house. The next point was to provide means for drawing the air *upwards* —an apparently easy matter. An ordinary cowl would, it may be imagined, effect this whenever the wind blew, by a kind of suction power. Here, however, lies the mistake that many people have made, for it is impossible to withdraw air out from the top of a tube which is closed at the bottom. Where such a plan has been found to answer in any degree, the place of the air so withdrawn has been supplied by other and fouler air from the sewers, which has forced a passage through some imperfectly sealed trap below. The cowl invented by Mr. Banner is of peculiar construction. It consists externally of a funnel-shaped tube placed horizontally on the end of the elongated soil pipe, and is kept with the wider end always facing the wind by an ordinary arrow. The wind, entering the larger end of the funnel, passes through this annular space, and in so doing creates a partial vacuum. By this means a circulation is kept up. The wind, which on an average blows from eight to twelve miles an hour, no sooner passes through the annular space than air is withdrawn from the soil pipe, and *fresh* air is admitted at the bottom. In fact, there is a regular circulation; air is constantly being withdrawn, and constantly supplied. On the day of our visit there was scarcely a movement perceptible in the air, yet a simple experiment showed the circulation was going on. It is a peculiar merit of the contrivance that the passage of the air must

be upward, not downward. We examined closely the condition of the air in the soil pipe, and found it perfectly inodorous.

"The principle thus applied to the ventilation of a soil pipe Mr. Banner proposes to apply to sewers. By establishing at suitable places the patent cowls, with a corresponding inlet to each, a circulation will be established, rendering the air within a sewer as nearly pure as that without. It may be said that it will not be wise to let out sewer gas to be breathed by the community at large, but it must be remembered, that it is the *confinement* of air in sewers which renders it impure. But by constantly passing fresh air through the sewers no such generation of gas can take place, and consequently houses can never be impregnated with it."

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## BANNER'S SYSTEM OF SANITATION.

### By Major H. C. Seddon, R.E.

**(From the *Architect*, January 15th, 1876.)**

"For the past few years there have been great advances towards remedying the evils to which the convenience of having water-closets inside our dwellings has chiefly given rise. Many have been the patents taken out for closets trapped in divers ways, as well as for sewer traps, till at one time freedom from sewer gas was generally supposed to be in direct proportion to the number and ingenuity of the traps intervening between the sewer and its different connections with the interior of the house. Then, however, the dreadful truth was announced that sewer gas, under pressure, could, nay did, force its way through all water traps, and that the suction caused by the passage of sewage matter through the pipes frequently unsealed the best traps by drawing the water out of them. *Now, however, an entirely new method of dealing with our soil pipes is being prominently brought before the notice of the public. This is known as the 'Banner System,'* after the gentleman who originated it in his defence, and who worked out the details which form such important features in its practical application. *Mr. Banner tells us that immunity from sewer gas is not to be obtained by a multitude of traps, but rather by having but one trap.* At one fell swoop he does away with all the traps upon which we have hitherto relied for safety. *By means of a very ingenious trap of his own invention, fixed at the foot of the soil pipe, he cuts off*

*effectually all communication between the soil pipe and the drain below.* This done, he induces a constant current of fresh air from the bottom to the top of the soil pipe, by means of a patented wind-cowl, fixed at the top of the soil pipe, above the roof of the house.

"An accurate description of Mr. Banner's system, and of the peculiar construction of his trap and wind-cowl, appeared in the *Architect* of November 20th last, under the head of 'Notes on Novelties,' the details of which need not, therefore, be repeated here; and in a subsequent number I wrote a letter drawing attention to certain points which seemed to me to require very careful consideration before the plan could be safely advocated for general adoption. Seeing that there was much to be said in favour of the system, especially as regards the fresh-air inlet at the foot, and the extracting force at the top of the soil pipe, I was anxious to see, in the first place, whether I had correctly understood the description given in these columns, and next, whether any satisfactory answers could be given to the queries in which I endeavoured to point out where failure was likely to occur. I will pass over Mr. Banner's answer to my queries, which appeared in the *Architect* of December 11th, except in so far as to state that I accepted his invitation to visit his house and judge for myself. I did so on the understanding that I was at liberty to write a full account of what I saw, and to give my opinions upon it, whatever those opinions might be. This is what I purpose now to do, first to give the result of my personal investigations into the working of the system, as exemplified in his house at Brighton, and afterwards to analyse its claims to supersede, in whole or in part, the most approved methods at present in use for removing sewage matter from dwelling-houses.

"Mr. Banner's house has a good external appearance, but, being on a terrace, is only open to the air at the back and front. The reception-rooms are large, lofty, and well lighted, and the bedrooms are of good size and height; in all there are seventeen rooms, besides the kitchen offices in the basement. The above is all that can be said in favour of the house, for, in my opinion, one worse constructed, so far as all accepted theories of sanitary arrangements are concerned, it would be difficult to find. The water-closets are placed in the very worst positions that could be selected. After passing through the entrance hall, you come upon the inner hall, with a well staircase lighted by a skylight near the roof. Off this hall is a water-closet, with another immediately above it on the second

floor, both being in the centre of the house and next to the party wall of the adjoining house, where no fresh air or other than borrowed light can reach them. Mr. Banner, however, set to work seriously, mastered the details connected with his own troubles, first carried up the open soil pipe above the roof of the house, and after many trials eventually *succeeded, and I say so on conviction, in constructing a trap which most effectually cuts off all chance of sewer gas finding its way into any part of the soil pipes within the house. This* was a great point gained, and seems naturally to have *led up to the next step, namely the outlet to the open air just above the patent trap at the foot of the soil pipe.* This became a necessity, owing to the air driven down the soil pipe by water descending from the closets above not being able to force the patent trap as it would an ordinary siphon trap; the result being, that it had to escape through the closet pans, and other trapped passages, into the house. This apparent objection to the rigid barrier placed at the foot of the soil pipe, no doubt suggested the idea of providing a free outlet below for the air forced down by the sewage matter in its descent. The soil pipe running down the centre of the house being now open to the air both at top and bottom, and effectually cut off from the sewer, *the crowning point of Mr. Banner's system was attained by placing a patent wind-cowl on the top.* The cowl is so constructed that the wind passing through it produces a constant draught up the soil pipe, drawing fresh air from the garden level below, and through any untrapped inlets in the house, and so setting up a continuous counter-current in opposition to any tendency of the fires, &c., in the house to draw supplies of air through the house connections with the soil pipe. The extracting power of the wind-cowl being once established, it became evident that the traps of the closets, sink, bath, and lavatory basin were no longer of any use, and therefore, being mere obstructions and receptacles for sewage matter, were removed, leaving nothing but the patent trap at the foot of the soil pipe to guard the way from the interior of the house and sewer, except, of course, the water in the pans of the closets when not in the act of discharging.

"Mr. Banner's patent trap, the working of which has already been described in these columns, occupies about the same space as an ordinary gas-meter, and is concealed from sight by a wood case in a recess in a cupboard, being fixed about 3 feet above the basement floor. About 6 feet above the trap are the closet and lavatory basin on the ground-floor, about 30 feet higher are the

upper closet and housemaid's sink, the bath being some 8 feet higher still, and the wastes from the bath and sink passing into the soil pipe just below the closet on the second floor, whilst that from the lavatory basin, on the ground-floor, discharges into the soil pipe just below the lower closet. The top of the soil pipe, upon which the extracting cowl is fixed, rises about 8 feet above the roof, and, being at the centre of the house, is not visible from the road. The communication with the outer air at the foot of the soil pipe is formed by carrying a 2-inch pipe just above the trap, under the dining-room floor, to the garden in rear of the house. From the foot of the soil pipe, which it is seen receives none of the refuse water from the kitchen, the drain runs, as already stated, under the kitchen floor and through the area, with a very considerable fall, till it joins the main sewer in the middle of the road, the total distance being about 45 feet; only receiving on its way what passes through the surface traps in the open area, and the contents of the servants' closet under the street pavement, and discharging freely into the sewer without any intervening trap or flap-valve.

"I will now describe what I saw of the practical working of the system in Mr. Banner's house, and of the tests to which it was put in my presence. Beginning at the highest point, namely, the patent cowl—which Mr. Banner informed me had been fixed for over a year, without once getting out of order—I first satisfied myself that it was performing its duty properly, veering with the wind, and drawing up air through the soil pipe; this was evident from the strong current of air passing in through the mouth of the air pipe, running from the garden to the foot of the soil pipe, as well as from a perceptible indraught through the untrapped pipes from the lavatory basin and the closets. It was plain, moreover, that no air could be passing from the soil pipe into the house. Passing down to the bottom of the soil pipe, we next watched, through the glass plate which forms the front of the patent trap, the action of the cup valve within, while copious discharges were sent down the closets above. By means of a strip of glass inserted in the front of the soil pipe, just above the top of the trap, the water could be seen rising in the foot of the soil pipe, until it reached a height of about 12 inches, when the weight of the column of water being sufficient to overcome the resistance of the weight at the end of the lever arm, forced the valve down, discharging the contents of the pipe above into the drain below *without unsealing the cup*, which, directly the discharge ceased, leaving only

the water retained in it when at its lowest point, closed up again with a slight deadened sound, against the indiarubber ring on the end of the soil pipe. The air-tight joint upon which the weighted lever was fulcrumed was simply and carefully constructed, and can safely be relied on to prevent the passage of sewer gas. *The patent trap itself formed a perfect barrier against the passage of sewer gas from the drain into the soil pipe above, and could not by any possibility be deprived by suction of the water which alone, when it is open, guards the way.*

"*In order to test the efficiency of the trap under extraordinary circumstances,* we passed *down from the closet above some corks, hair, and a piece of an old curtain about the size of an ordinary duster.* The piece of white curtain was seen to pass straight through the trap, which, however, did not close after it, though, of course, the water seal was maintained. *Hot water* was then discharged from the *upper closet,* whilst I stood by the outlet pipe in the garden, from which the air in the soil pipe rushed with considerable force, but *without any disagreeable odour that I could possibly detect,* though I fancied I perceived a very faint smell with the first rush which certainly would have been expected after treating with warm water the inside of a soil pipe which had been more than twenty years in a position, and which must necessarily be fouled by every discharge from a closet. *In order that we might examine into the state of the cup valve and the indiarubber ring against which it closes, the glass front to the trap was then removed. The cup itself was in perfect order, and free from any solid matter* beyond a slimy coating of lime, which the water deposits on all surfaces with which it comes in contact; *whilst the indiarubber ring appeared to be as sound as when first put on, more than two years* ago, owing, no doubt, to its constant immersion in water free from destructive agents, such as grease.

"When the front of the trap had been replaced, I poured some strong scent *into the mouth of the air pipe leading from the garden to the soil pipe,* in order to ascertain whether the air passing into the soil pipe might not, at intervals of unequal action, find its way into the house, as well as out through the wind-cowl. *I was unable, however, to detect the odour of the scent in any part of the house, and must therefore conclude that the suction of the wind-cowl was at all times sufficient to overpower that of the house.*

"*The result of stopping up the mouth of the air pipe* leading from the garden was shown by discharging water from the pan of the

upper closet, the effect on the lower closet being that the air in the soil pipe—*finding it impossible to force the patent trap below*—in its efforts to escape, first raised the level of the water in the pan, and finally burst through, *sending the water flying in all directions.*

"The same operation was then repeated, only with the lever of the patent trap raised, so as to put it in the condition of an ordinary water-sealed siphon; the result was that the air forced the trap without repeating the commotion in the pan of the lower closet. Finally, leaving unstopped the mouth of the air pipe, and removing the plug of the lavatory basin on the ground-floor, water was again discharged through the upper closet, in order to see whether, under such circumstances, air could be forced into the house through the waste-pipe from the basin. Such, however, was not the case, but there was rather a suction through the waste into the soil pipe.

"This closes the account of my investigations into the practical working of Mr. Banner's system of sanitation, as far as I found it had been carried out in his own house. I have no hesitation in saying that *it worked admirably*, and that he has succeeded in rendering his house *absolutely secure against that most insidious of enemies, 'sewer gas.'*"

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## "SEWER GAS.

(From *Public Health*, April 8th, 1875.)

"Like many other of our engineering systems, that of the removal of excretal and refuse matter originated through accidental circumstances. The oldest sewer in the world, the *Cloaca maxima* at Rome, was constructed for the drainage of part of that city. At a subsequent date, the inhabitants began, doubtless upon the principle of 'out of sight, out of mind,' to avail themselves of the ready means which this channel afforded them of getting rid of refuse matter, so that, by degrees, the monster drain became what its name implies — the main sewer, the *Cloaca maxima*, of Rome. From this second use to which it was put, the sewerage system now in use in most large towns may be said to have taken its rise.

"Theoretically, the plan of removing refuse matter by water carriage has much to recommend it. The excretal matters are conveyed from the houses into the sewers, expeditiously and easily. So

far, all seems well. But at this point, namely, the connection of the house pipes with the sewer, we arrive at the first of the difficulties which surround the system, and which may render it injurious to health in the highest degree.

"There are only two available modes of diminishing this evil—(1) by frequent flushing with water, so as to wash out the sewer, and (2) by ventilating the sewer, in order to prevent the accumulation of pent-up sewer gas. The former of these, even when large volumes of water are available for the purpose of flushing, is too temporary and insufficient to be regarded as a positive means of removing the danger; and, at the best, can only be looked upon as an auxiliary measure. *Ventilation is the only certain remedy*, but, as it is *commonly* practised, it is *merely a delusion and a sham.* The ordinary street-grating ventilators are so constructed and so placed that, within forty-eight hours after they have been cleansed, they are again choked, and rendered impervious to the air from the sewers; and as, in the vast majority of instances, they are seen to only once now and then—it may be in several weeks, or several months—they are simply useless, or worse than that, owing to their engendering in the mind of the average British householder a feeling of safety, which has no foundation except in imagination.

"*Virtually, then, ventilation of the sewers is, in a great measure, carried on through the connections which exist between them and our houses.* Sewer gas, like other volatile bodies, declines to be imprisoned in the place where it originated, and is constantly seeking for a weak point at which its exit may be effected. Such opportunities are unfortunately very abundant at the junction of the house pipes with the sewers, and the inevitable consequence of defective joints or weak traps is the passage into the house of sewer emanations, which must, sooner or later, act prejudicially upon the health of the inmates. First, the children suffer; next the adults, especially those whose occupations keep them much within doors. Not only the air that they breathe is poisoned in this manner, but often also the water that they drink.

"*As we have already stated, the best general means of diminishing this danger is by free ventilation of the sewers.* '*Ventilate, ventilate, ventilate!*'

"There are very few towns where the sewers can be said to be *properly* ventilated, *and we must protect each house separately if we are to combat the difficulty effectually.* Sewer gas often plays an important part in the causation of various affections; and notably

of typhoid fever, which although it is, in point of fact, a preventible disease, is credited with 20,000 deaths annually in the Registrar-General's returns, whilst, probably, 100,000 more persons (the mortality being 1 in 6) are laid upon a bed of sickness for many weeks, and their constitution undermined and enfeebled, by the same preventible disease which, were it not for the pollution of air or water by sewer gas or sewage matter, would scarcely ever occur.

"Up to a recent period, we held the opinion that all drain-traps were apt to be inefficient or to get out of order, but opportunities that we have had of examining, at different times and under different general conditions, a system invented by Mr. E. G. Banner, have led to a modification of this opinion; and *we have further arrived at the conclusion* that *the inventor has solved the difficult problem of how to keep sewer gas out of our houses.* Mr. Banner's drain-trap was brought under the notice of our readers in *Public Health* of December 16th, 1874. The writer sums up the merits of this apparatus as follows:—'It is self-acting, always air-tight, flushes clean, and cannot be unsiphoned.'

"In this manner the house will always be effectually trapped against sewer gas; and we are able to dispense with D traps, which, from their conformation, are, in point of fact, miniature cesspools, and with other unreliable contrivances. One of Banner's traps at the basement of the house, which may be placed above the level of the basement, like a gas-meter, is sufficient for all the closets in a house.

"In connection with the question of sewer gas we must not omit to mention another valuable appliance devised by Mr. Banner. Every one knows that ventilating *shafts* communicating with the soil pipes are recommended by leading authorities upon the subject. Although the theory upon which they are constructed is good, they are not always of practicable utility. *There is a difficulty in getting sewer gas to ascend a long perpendicular pipe, while in some conditions of the atmosphere there may be a down draught instead of an upward current.*

"Mr. Banner obviates these drawbacks, and at the same time insures a constant *upward* current, by placing at the top of the ventilating shaft a cowl, so delicately balanced that the least breath of air creates a suction power which draws the air out of the ventilating shaft into the atmosphere. These cowls can be used anywhere *and are a necessary adjunct to shafts, ventilating soil pipes, &c.* The benefit that would result to the community from their general adoption cannot be over-estimated, as each would contribute to the

ventilation of the sewers as well as of the pipes of the houses where they were fixed.

"On one occasion of our seeing the apparatus at the inventor's house, where they have been in operation for more than twelve months, there were present a number of gentlemen interested in sanitary matters, including several Medical Officers of Health for large and important districts. The apparatus received the highest commendation of all present, whose favourable judgment fully confirmed the opinion at which we had previously arrived."

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## "BANNER'S SANITARY APPLIANCES.

(From the *Building News.*)

"SIR,—It seems to me rather useless to discuss this matter with Mr. Buchan, as he acknowledges he has not seen nor endeavoured to prove Mr. Banner's appliances, and I have done both the one and the other; and I should not have replied to his letter in your last on that ground, but that others might imagine that the objections he has brought forward theoretically alone have some weight in disparaging a system which I consider has conferred a practical boon upon the public.

"Mr. Banner has shown how pipes can be instantly emptied, and kept empty of all gases, and has thereby done good. If, instead of the term 'sewer gas,' I had said 'sewage gas,' it might have been better, and I should have been in order when remarking upon those foul gases which are generated in branch drains as well as in sewers. But when Mr. Buchan comes to speak of what he calls the heart of the system, and goes on to say that it is not new, but has been tried before and failed, I say he knows nothing of what he has taken no trouble to examine, and jumps at erroneous conclusions. *It is no wonder that the attempts which he described came to grief for want of the very extracting power of the cowl which he ignores. This power is not only a matter of theory, but has proved perfectly successful in practice.*

"Mr. Buchan himself acknowledges the correctness of *the key-note of Mr. Banner's system*—namely, the ventilation of the bottom as well as the top of the soil pipe, but prefers to do without the patent cowl and trap. *If the cowl be omitted, then traps become necessary to all the pipes, as he says.* But Mr. Banner has shown us *that the latter are needless if the former be provided.*

Feeling sure that Mr. Buchan only wishes, with myself, to find out and support what is really useful, I would advise him to go and see Mr. Banner's appliances before he writes any more in opposition to them, in order to air his own theories, and I certainly shall not answer him again till he does. I have already said that I think much of what Mr. Banner has effected might be done more simply, but this is, however, mere theory, for I have not done it, and, until some one does, householders cannot do ill in making use of a system which is neither costly nor elaborate, and *which does thoroughly effect what it proposes—namely, to render houses wholesome which are now mere* DEADLY FEVER-TRAPS, *whether they be mansions in Belgravia or cottages in the suburbs.*

"I am, &c.,

"1 Queen Anne's Gate, Westminster, JOHN P. SEDDON.
*January 26th*, 1876."

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(From the *Architect*, April 8th, 1876.)

"SIR,—I desire to add my testimony to the perfection of a system which has been rightly and pithily described as being '*at once so simple, yet so effective.*' I have heard scores of other sound practical men make similar remarks. Indeed, I might again quote the language of the author of 'Paradise Lost,' and say :—

> "'The invention all admir'd; and each how he
> To be th' inventor miss'd, so easy it seem'd
> Once found, which, yet unfound, most would have thought
> Impossible.'

"One of the best proofs of the value of a discovery is the amount of envy or imitation which it excites. It is really amusing to observe how one set of men will occupy themselves with detracting from the merits of any good thing which they did not themselves find out, while another set will deliberately assert that they knew all about it long before. Such is the present aspect of the case as regards Banner's system. There are numerous individuals who, not understanding its excellent points, depreciate them, and *there are other persons who, understanding them, coolly try to appropriate them.*

"I will close my letter by stating, in evidence of my being in a position to express an opinion upon Banner's system, that from the date when the first published account of it appeared in *Public*

*Health*, I have had the system under my notice, and that I have arrived at the conclusion that it accomplishes everything that is aimed at, and all that can be desired, by the absolutely certain manner in which it excludes sewer gas from houses.

Your obedient servant,

"London, *April 4th*, 1876." "S.

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## "SANITARY IMPROVEMENTS AT THE HOSPITAL.

(From *Guy's Hospital Gazette*, January 1877.)

"We redeem a promise to our readers to give a more lengthened notice of the alterations made on the east side of the hospital, with the view of improving the sanitary condition of the surgical wards, and which were referred to in a previous number. We may as well premise that, prior to the adoption of the 'Banner system,' much had been done to render the sewers in this division of the hospital more efficient, by the substitution of glazed earthenware pipes for the numerous brick barrel drains which had been made to do duty for an indefinite period. These latter were found in many parts of their course to have suffered from decay and consequent leakage, mainly attributable to the energetic incursions of successive colonies of rats, which appear to have retained an undisputed possession of the Stygian domains for upwards of a century, and, probably, as long as the hospital has existed. After securing a free current for the soil underground, to its point of junction with the Metropolitan sewers, it became a question of not less moment how the escape of sewer gas into the wards and other residences was to be prevented; or, in other words, how the soil pipes and minor conduits leading to the drains, as well as the drains themselves, were to be ventilated. Now, in nearly all private houses, and certainly in all public institutions, the reflux of sewer gas into the habitable apartments is restrained, or sought to be restrained, by means of valves or traps placed immediately under and continuous with the soil pipe of the w.c., and the ingenuity of plumbers and of sanitary engineers has been taxed to the utmost to discover the best apparatus for this purpose. An infinite variety of siphons are consequently in use, each professing to impose a sealed barricade on the noxious intruder, but experience, of late years especially, has shown that, under certain conditions of the weather, both above and below

ground, the supposed safeguards are not only valueless, but very often mischievous. It has also been repeatedly shown that the D trap, in such universal use, becomes in time so encrusted with deposits from the soil *as to prove a source of danger of itself*, independent of its faulty action. In what is unquestionably the best w.c. yet introduced, viz. Jennings' Patent Valve, in which the basin and trap are made in one piece of imperishable earthenware, and provision is made for continuous flushing, the inventor has thought it necessary to supplement the siphon action by a process for discharging a small quantity of disinfecting fluid into the pan every time it is used, mainly with the view of neutralising the pernicious effect of reflux sewer gas from the valve, but it is clear that in all these attempts at removing a nuisance we are beginning at the wrong end. What we wish to effect is, first, a free passage to the soil downwards; and, secondly, an equally free exit to the sewage gases upwards, and at the same time to render them perfectly innocuous by free admixture with the external atmosphere. How this has been done at the hospital through Mr. Banner's intervention may be partially seen from the accompanying sketch intended to illustrate the manner in which the soil pipes are ventilated, and also the means adopted for securing a free circulation of air in the drains. (See Fig. 17, p. 48.)

"The main object sought for is a continuous atmospheric current, which, when once obtained, must carry the mephitic nuisance, in a highly diluted form, free out of harm's way above the level of the roof. In the case of the soil pipe, this is effected by the inlet pipe E at its base and by the foul-air-withdrawing cowl C which surmounts its upper extremity. The inlet pipe is placed immediately above the single trap which guards the communication betwixt the soil pipe and the drain, and is fed continuously from the external air, while the cowl is so constructed as to exert at all times a considerable suction-force on the air in the pipe, and thus to maintain a current, variable with the wind's velocity, *but still permanent.* Nearly every one is familiar with the ventilating tube attached to the soil pipe in private houses, so strongly recommended, and even insisted on by numerous sanitary authorities, to facilitate the escape of sewer gases. This air or safety-pipe is doing good service as far as its limited powers permit, but it cannot be too strongly borne in mind that the contrivance can only act intermittingly, and then only under certain fixed conditions. For the most part the air in soil pipes and drains is stagnant, and *in this*

*state* it is known to vitiate the water in traps, and unless counter openings are made, for the double purpose of admitting and withdrawing air, we have no security against the foul effects of deleterious gases, simply because we are deprived of the means of keeping up an atmospheric current. Again, to prevent any communication betwixt the drain and the soil pipe, and thus nullify the action of the fresh air from the inlet tube, Mr. Banner has introduced a trap of peculiar construction (an illustration of which is given at Fig. 3, p. 20).

"The trap is very simple and effective; it is cast in iron, and in the drawing the outer plate has been reversed so as to show its internal mechanism. One of these traps will suffice for any number of closets placed separately on floors above. There are two underneath the scullery projection of Accident ward, each doing service for four of the w.c.'s of the wards above, and since their introduction they have never been at any time unsiphoned. The trap has a double dip, and, while its depth is only five inches, there is a vertical fall of two feet between the two dips, which would leave a space sufficient to contain a couple of gallons of water exerting a downward force of over 20 lbs. on the lower dip, while the fall of water from the ward closets has been found amply sufficient to keep the upper dip free from any obstruction.

"We have already referred to the wind-cowl as the main *motive* agent for *maintaining* the continuous upward current. *That it does so effectually, by utilising the aspiratory force of the air, is beyond question; but it does more than this.* Its suction force, though mainly employed in extracting the vertical column of air in the soil pipe, is also imparted to the minor conduits connecting it with the numerous soil pans, as has been repeatedly shown by the familiar experiment of holding a lighted taper over the pans to test the direction of the current. *From this circumstance Mr. Banner has felt justified in dispensing with the numerous traps, whether metallic or earthenware, attached to each closet, and has thereby got rid of a constant source of annoyance and expense, besides securing us an immunity from an ever-fruitful source of danger.*

"The diagram (Fig. 17, p. 48) also shows the manner in which the drain outside and running parallel with the hospital is ventilated. This drain is about 250 feet in length, and receives the soil and waste water from the wards and officers' houses on this side of the building. It is continuous throughout—that is to say, there are no siphon obstacles betwixt the various residences to interfere

with the two soil currents which coalesce on account of the gradients near the centre, where they pass through a large earthenware siphon into the main sewer of the hospital. A free passage through the whole extent of the drain being thus obtained, its ventilation has been secured in the following manner:—At one extremity of the drain a down-cast shaft A has been introduced, surmounted with a wind-cowl, with a cup-shaped orifice always exposed to the full force of the natural atmospheric current, and air being freely admitted from this source to the drain, the circuit is completed by an up-cast shaft at the other end B, which is capped with a large foul-air-withdrawing cowl. Each shaft rises 10 feet above the roof of the hospital and is over 50 feet in height, so that we have here a channel of 350 feet in length, through which the air is made to traverse always in the same direction, a space dealt with, considering the number of houses and their numerous occupants, equal in extent to the side of a square or division of a street, and from the drain to the large hospital sewer *there is but one outlet, which in its turn is guarded both at its entrance and its point of junction* with the Metropolitan sewer by a similar apparatus. It may be noticed that the system of sewer ventilation here referred to is not dissimilar to that employed in coal mines or on board ships, and is the same in principle as that advocated by Desagulier, Reid, Peclet, and their numerous imitators, differing only (and the difference may be considered by many fatal to the theory) in the absence of an intermediate motive force to regulate the currents. *So far as our experience enables us to judge, the system appears to fulfil all the conditions specified in the contract. There is no foul air generated in the w.c.'s. The several currents in the soil pipe, in the drain, and in the large sewer have uniformly been found to be flowing in the right direction whenever they have been tested (and this has been done repeatedly), while no inconvenience has arisen from the removal of the numerous traps and other apparatus which were thought to be the only safeguards of our closet system.*

"It is very likely that exception may be taken to some of the principles on which this novel system of sanitation is based, and it is but right that it should be so. It may be open to question whether in a large city of varying levels, and among a dense population, it is preferable to have every house and drain evolving its noxious effluvia* into the outer abyss, to having it pent up under-

* N.B.—As stated a few lines above, there is no foul air generated in the w.c.'s, *neither is there in the soil pipe or the drain.*—E. G. B.

ground and insidiously finding its way into habitable apartments, and from the notoriously eccentric character of atmospheric currents are we by any means assured that they will at all times follow the orthodox course; but these are matters that may be safely set aside for the present. It is sufficient for us to know that in this simple invention we have the means at our command of grappling with a great practical evil of ever-increasing dimensions, which has hitherto baffled the skill and ingenuity of architects and sanitarians, and the merit of the remedy is not the less commendable because it comes to us through the originality of a gentleman who, whatever his other accomplishments are, admits himself to be a mere novice in the art of sanitation."

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## "SANITATION AT GUY'S HOSPITAL.

(From the *Metropolitan*, December 16th, 1876.)

"In the early part of this year we took the opportunity of describing a method of ventilating soil pipes introduced by Mr. E. G. Banner, of Billiter Square. It will be remembered that we paid a special visit to that gentleman's private residence at Brighton, where, having previously some vague notions of the theoretical part of the business, we had the advantage of learning some practical details by seeing the system in operation. We were thoroughly convinced of the efficacy of the plan, and described the action of the mechanical appliances used and the principles upon which they acted. There was no doubt about the matter. Mr. Banner's house was at one time almost uninhabitable by reason of the sewer gas which pervaded it; but ever since his system—born of the necessity for it which existed in the house—has been applied, the most perfect freedom from noxious effluvia has existed. Many scientific persons have inspected the house, and have done their best to find a flaw in the system, but those who arrived as sceptics went away convinced, some very much against their will. This was a great triumph so far, and we believe many other houses have been treated in a similar way with unvarying success. It is not to be wondered, therefore, if Mr. Banner desired to make more extensive experiments, so as to see if that *bête noir*, gas in sewers, could not be got rid of. Opportunity has not yet served for dealing with an entire system of sewerage, but a result has recently been achieved

at Guy's Hospital which shows that, properly applied, Mr. Banner's system of sanitation is a great fact.

"A short time ago we inspected the improvements effected by that gentleman in a large block of buildings forming part of the above hospital. We regret exceedingly that we did not view the premises before the alterations were made, so as to have compared the former with the present state of the building. At present there is not the slightest amount of effluvium in any of the wards, passages, or closets, but we have been assured that formerly sewer gas was the prevailing odour. The system of soil pipes and drainage was upon the most unsanitary principle imaginable. The drains were, and still are, in the worst possible position, and the soil pipes were not even carried up to the upper part of the building, but were carefully sealed at the top, so as to encourage a rush of sewer gas into the closets and wards every time the closet-handle was drawn up. The interior of the pipes may be imagined, when it is said that some of them were 150 years old, well encrusted with hardened soil, fouling the already foul air within.

"It would be difficult to convey, without the aid of diagrams, a complete idea of the alterations which have been made at the hospital. Our object is to explain the principles upon which the ventilation has been effected, rather than to describe minutely the mechanical details. We may say, however, that all the D traps in this part of the hospital have been removed, and each soil pipe is virtually cut off from the drains by a Banner's patent double dip trap. The drains have but one delivery into the sewer, and the whole drain, several hundred feet in length, is ventilated by means of an inlet through an old grating and a vertical shaft at the opposite end with a patent cowl at the top. Another section of drains is ventilated by means of two shafts carried up to the top of the building, one having an inlet cowl, the other with a patent outlet cowl. Each soil pipe is provided with an inlet pipe at the lower end, and a patent cowl at the upper.

"The conclusions to be drawn from an examination of the improvements at Guy's Hospital are important. The principal is the fact that the system is practically shown to be applicable to a series of buildings as well as to single houses. The various departments of the block we have been referring to are, although not disconnected, virtually distinct buildings, so far as closets and soil pipes are concerned. The frontage of the block, or rather the area drained, is equal to that of about forty ordinary houses, and it is no

slight thing to thoroughly ventilate all the sewers and pipes connected with it by one process of treatment. Another point to note is the further confirmation of the soundness of the principles upon which Mr. Banner's system is based. It shows indisputably that a tube whether it be straight or crooked, can be constantly ventilated by means of a continual current of pure air passing through it, providing there is an inlet at the lower end, and some kind of drawing or exhausting power at the upper. There must be these two conditions. An inlet without the drawing power, such as a properly constructed cowl, amounts to nothing; and a cowl alone, without any inlet, is perfectly inoperative. *It is amusing to note how loth some sanitarians are to admit this self-evident fact.* They seem to believe that a tube may be ventilated by having both ends open, without any drawing power whatever. This might be, if elevated high above the ground, and fixed horizontally; but sewers, drain, and soil pipes are not placed in such a position. Then, again, they argue that a sewer can be ventilated by inserting a long, open, vertical pipe at each end, and that by some natural law, which they do not explain, air will spontaneously rush down one tube, pass along the sewer, and ascend the other in the most obliging manner, without having any particular inducement to do so. Let such theorists simply take a tube bent into this shape—U—and apply smoke at one end, and see if the 'natural law' they speak of will make it go down and up again. Place, however, an exhausting cowl at one orifice, and it will descend at once. This is the principle upon which the sewers are ventilated at Guy's, and no '*natural law*' *would cause air, as it now does, to go down a grating some* 12 *feet, traverse a drain* 300 *feet in length, where sewage is flowing in an opposite direction, and then ascend a pipe* 50 *or* 60 *feet in height. There must be an exhausting power, or no circulation can possibly take place.* That there is a constant current in the ventilating arrangement at Guy's Hospital we can testify. *The atmosphere at the time of our visit was dull, aqueous, and almost motionless, yet, by testing, we found there was a decided inward current at the inlets,* and we ascended to the topmost parapet of the building, and, *climbing to the orifice of the cowls, found there was an outward current containing only the faintest suspicion of odour. The system introduced by Mr. Banner has now undergone a crucial test, and can only be looked upon as a great* fait accompli."

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"ESCAPE OF SEWER GAS INTO HOUSES.

(From the *Journal of the Society of Arts*, June 29th, 1877.)

"GUY'S HOSPITAL, *May 8th*, 1877.

"SIR,—I regretted I had not an opportunity, when at the late Conference of the Society of Arts, to have entered into the discussion in reference to your system of sanitation, as carried out to a portion of Guy's Hospital. I intended to have stated that, having had it in operation now for upwards of six months, I was perfectly satisfied with its results, both as to the patent traps as well as to your patent wind-cowls, neither one nor the other having been found, after careful watching, to become unsiphoned or out of order.

"I believe the action of your wind-cowls, placed upon the top of the soil pipes, when coupled with the air inlet pipe, *as in your complete system*, to be quite effectual in maintaining a continuous upward current, not only through them, but also through the drains where they have been so arranged. And even more, their power of suction has been found, by repeated experiments of a lighted taper placed in the closet pans, to show the downward direction even of the current entering the soil pipes.

"You are, therefore, quite justified in dispensing with all D and other traps beneath each closet (which really are nothing better than cesspools on a small scale, proving always a constant source of annoyance and expense, as well as great danger, when retained). Thus you are able to withdraw from the drains, as well as from the soil pipes of the closets, sluice-pans, &c., of the different wards of the hospital where your system has been applied, during all winds and all weather, the foul air or gas from within them, and replace it entirely with a current of fresh air. *I consider this fact alone to show the great blessings it must have conferred upon the inmates of the hospital, and believe it to be worthy of universal adoption.*

"Yours faithfully,

(Signed) "ARTHUR BILLING,

"Surveyor to the Hospital."

In an abstract of his Essay, to which the Howard Prize Medal for 1876 was awarded, published in the 'Journal of the Statistical Society' for June 1877,

Dr. Steele, after touching upon the importance of excluding sewage gas from hospitals, and the superior merit of the Banner system for this purpose, shows how it has been effected at Guy's Hospital, and adds that no exception had been taken to the new arrangements in applying it to this institution, and that it appeared

"to act well in all weathers, in foggy days as well as in high winds, when sewers and soil pipes are most liable to be filled with sewer gases. The system also does away with what has hitherto been a necessity, namely, siphon traps, and elaborate machinery in connection with waste water and cistern supply, as well as with the closets themselves."

## TESTIMONIALS.

SURVEYOR'S OFFICE, GUY'S HOSPITAL, London, S.E.,
*October 20th*, 1880.

SIR,—In a letter signed "W. P. Buchan, Sanitary Engineer," of your last week's impression, on "The Evils of Trapping in Connection with Closets and Drains," a statement is made that "the attempt to do without water traps, tried at Guy's Hospital, London, had ended in failure." Allow me to say that, as far as the above hospital is concerned, the water-closets, sinks, and baths, &c., remain precisely in the same state in which they were left by Mr. Banner in the autumn of 1876, now upwards of four years ago, the water-closets having only the water traps in bottom of basins, and the water from baths and sinks simply siphoned off by bending the waste-pipe in each case. . . . I will only add that, until a better, and, if possible, more simple plan (which I greatly doubt) can be devised, I should be very sorry to have any alterations made in the existing arrangements.—I am, &c., ARTHUR BILLING, F.R.I.B.A., (Surveyor to the Hospital).

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RURAL SANITARY AUTHORITY, NEWPORT PAGNELL,
*September 27th*, 1880.

SIR,—In reply to your note, I have much pleasure in giving you the result of my experience of Mr. Banner's system of ventilation,

either for public or private buildings, or more important still, the ventilation of sewers. I have seven cowls connected with different sewers, all of them distinct one from another, and all different sizes. I may note here that in all these cases we are similarly situated to yourself, as we have no water supply in either case, only from wells which are shallow; you will not find this any serious difficulty, provided you have no part of your sewers actually stopped up. I am fully convinced from actual experience of the Banner system, extending over five years, that if properly adapted to your existing system of sewers by some one thoroughly acquainted with the system of ventilation, the nuisance you complain of can be removed. If on the spot, I could have given you some practical hints, and also have illustrated to you the mode in which we have adapted the system to our sewers, but should you require any further information, I shall be pleased to give it.—Yours truly, GEO. W. BRANSON.

W. W. BROWN, Esq., Evesham.

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SOUTHFIELD GRANGE, WANDSWORTH, S.W.

SIR,—As the subject of soil pipe ventilation is attracting so much attention just now, the following may interest your readers:—My house had been constructed regardless of all sanitary considerations, and the plan of it is such as to make alterations difficult. I had made various attempts to remove existing evils, but only succeeded in mitigating them, until last summer I handed it over to Mr. Banner. He cut away the D traps, but left the pan closets in two of the w.c.'s, and ventilated the drain and soil pipes with his patent appliances. Since this has been done, I have had no trouble or inconvenience, except with the ball-tap of a Pearson's closet, put in by Mr. Banner. Owing to defective water supply, and the manœuvres of the Southwark and Vauxhall Water Company, for three days scarcely any water passed down one of my closets, which is situated in the middle of the house; nevertheless, there was no trace of nuisance, even when the handle was held up.

I have stood at the "inlet" when one of the closets was used, and though my hat was nearly blown off by the rush of air from the pipe, neither I nor an unprejudiced friend standing by could detect

any nuisance. Smoke showed that the up-current was immediately re-established; but I have not succeeded in demonstrating by smoke the existence of a current in the ventilated drain.—Your obedient servant, G. B. LONGSTAFF, M.B., M.R.C.P.

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Your system at the Royal Infirmary, Ryde, continues to act perfectly, and I am applying it in all cases where I have the opportunity. —THOMAS HELLYER, Architect to the Infirmary.

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BARON'S COURT, *December 6th*, 1879.

SIR,—I am glad to give my testimony of the complete success of the system which you have inaugurated at Baron's Court and at my London residence, Hampden House, for the sanitary security of the drain, and I see no reason to doubt its complete success for the future. The system appears to be both simple and effective, and one which is not likely to suffer any derangement.—Faithfully yours, ABERCORN.

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*January 16th*, 1880.

In reply to your letter, I have much pleasure in stating that I am quite satisfied with the Banner system of drainage and the ventilation of drains, soil pipes, &c., as carried out at Burghley House. The works have been completed for a considerable time (two and a-half years), and all appears to be going on satisfactorily.—Your obedient servant, EXETER.

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46, BELGRAVE SQUARE, *November 27th*, 1879.

In reply to your inquiry, I have pleasure in stating that I am quite satisfied with the Banner system of sanitation, embracing ventilation of drains, soil pipes, &c., as it has been carried out at my Irish seats, Headfort House, and Park Lodge, Virginia, as well as at 46, Belgrave Square. I know that the work at Headfort was a difficult one, as I saw it at different stages as it progressed. I am not only satisfied with the result worked out by your system in a sanitary point of view, but also consider the charge made for the important work done very reasonable.—HEADFORT.

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95, Eaton Square, *December* 13*th*, 1879.

Lord Erne has much pleasure in bearing testimony to the efficiency and thoroughness of Mr. Banner's system of sanitation. Nothing can be more perfect, both in theory and practice, than the system when carried out in its entirety.

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Hainton Hall, *December* 13*th*, 1879.

I was very much pleased by the way in which the Banner system of sanitation was carried out with regard to my house and drains, and consider that it was a complete success.—E. Heneage.

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Monk's Tower, Lincoln, *November* 17*th*.

As far as I have had experience in the Banner system of drainage it has answered perfectly at Osberton, but of course a few months is hardly sufficient test. It appears, however, that it is impossible with such an arrangement for sewer gas to find its way into the house.—F. J. S. Foljambe.

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Bedford House, Streatham.

The sanitary alterations carried out at my house have given us complete satisfaction, and entirely removed the offensive smells of which we so frequently had to complain before. The system you have introduced seems altogether the most perfect I have anywhere seen.—Faithfully yours, Wm. Grantham.

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61, Old Broad Street.

I believe in your cowls, and I am, perhaps, as impartial a judge as can be found.—H. H. Collins, F.R.I.B.A., Surveyor for Eastern District, City.

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Moreton Pinkey Vicarage,
*January* 31*st*, 1880.

The sanitary work done by you at my vicarage in 1877 has proved quite a success, and I never lose an opportunity of recommending your system.—N. D. White.

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I have had, I am sorry to say, too much experience as to the absolute necessity of attention and alteration being required in the matter of drains and ventilation, even in the most recently constructed and costly mansions.—ROBERT RAWLINSON, C.B.

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Although there are appliances and arrangements by means of which the sewer gases may be effectually prevented from entering houses, they still do so in the great majority of dwellings, both in town and country, including the metropolis.—SOCIETY OF ARTS.

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CHILDS' HILL, FINCHLEY ROAD, *May 10th*, 1875.

I owe you many apologies for being so long in sending you my detailed report upon your trap and ventilating cowl, but the fact is I wished to carefully compare it with some others that I had heard a great deal about. It was only on Saturday last that I fairly tried, for instance, the Boyle (Glasgow) ventilator, which is meant to perform similar functions to your own cowl. I wish to say now, that I will forward you a fair copy of the report upon your inventions next week, for I have had it made out some time.

The conclusion I have come to, after a considerable time spent upon their study is, that they are the best *media* out for the work which they are intended to compass, that I can confidently recommend them, and that they ought to be specified by architects generally, especially for country houses.—WM. EASSIE.

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The following are some of the more important places amongst thousands of others, at which the Banner system has already been applied:—

His Grace the Duke of Abercorn, Baron's Court, Ireland.
His Grace the Duke of Sutherland, Stafford House, St. James's.
The Marquis of Exeter, Burghley, Stamford.
The Marquis of Headfort, Headfort House, Kells; Park Lodge, Virginia, Ireland, and 46, Belgrave Square, London.
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